FIG. 1

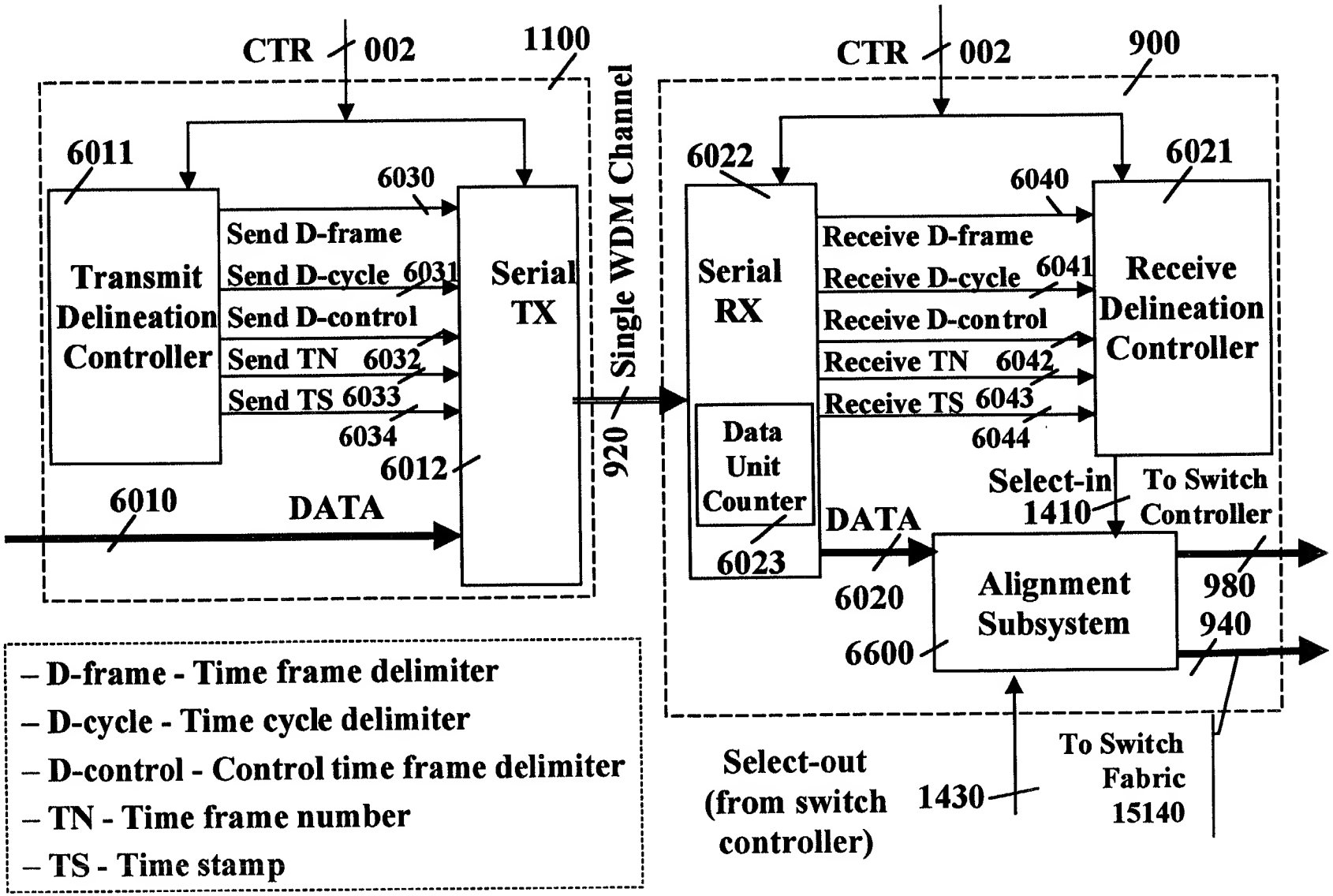


FIG. 2

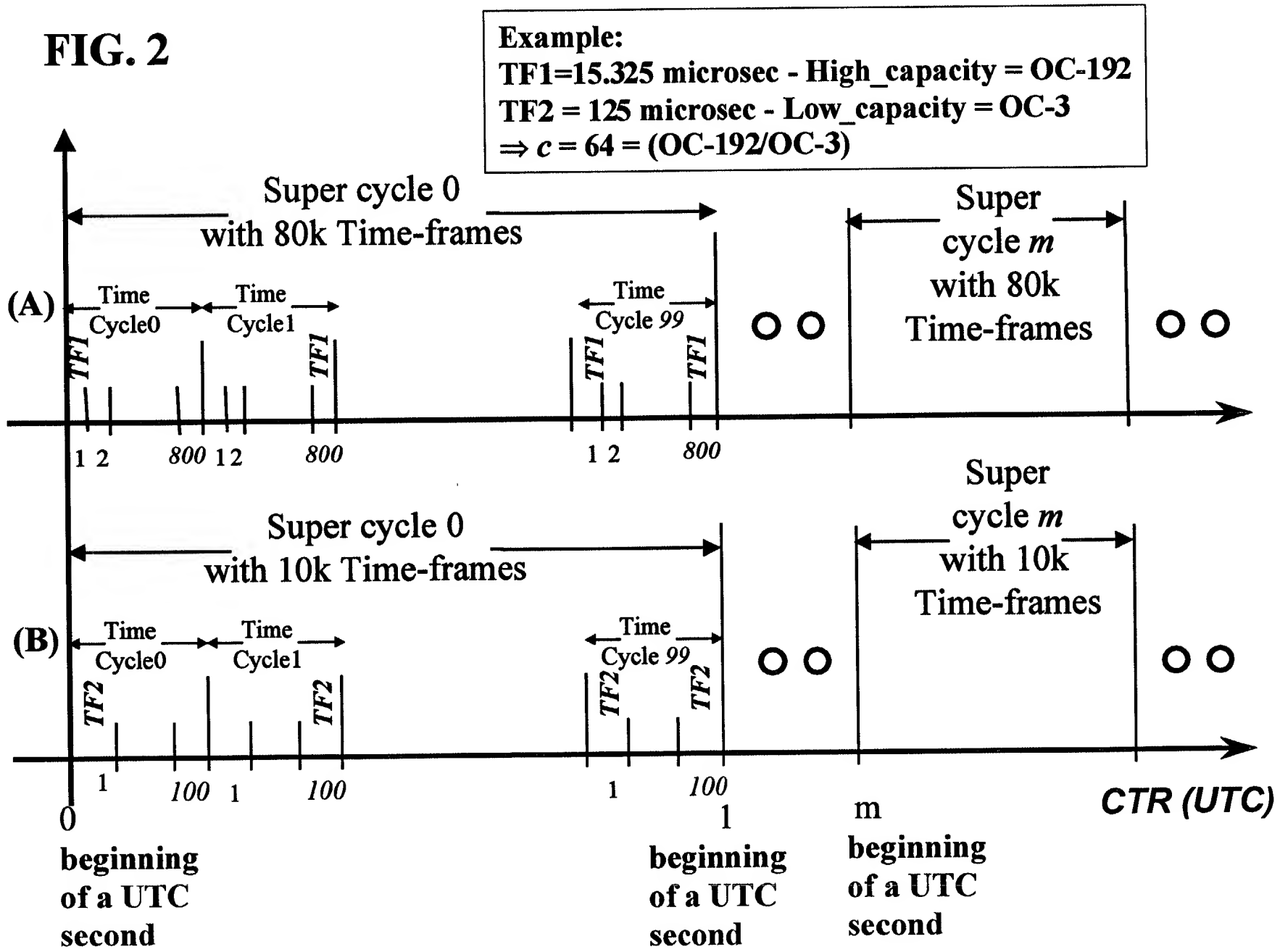


FIG. 3

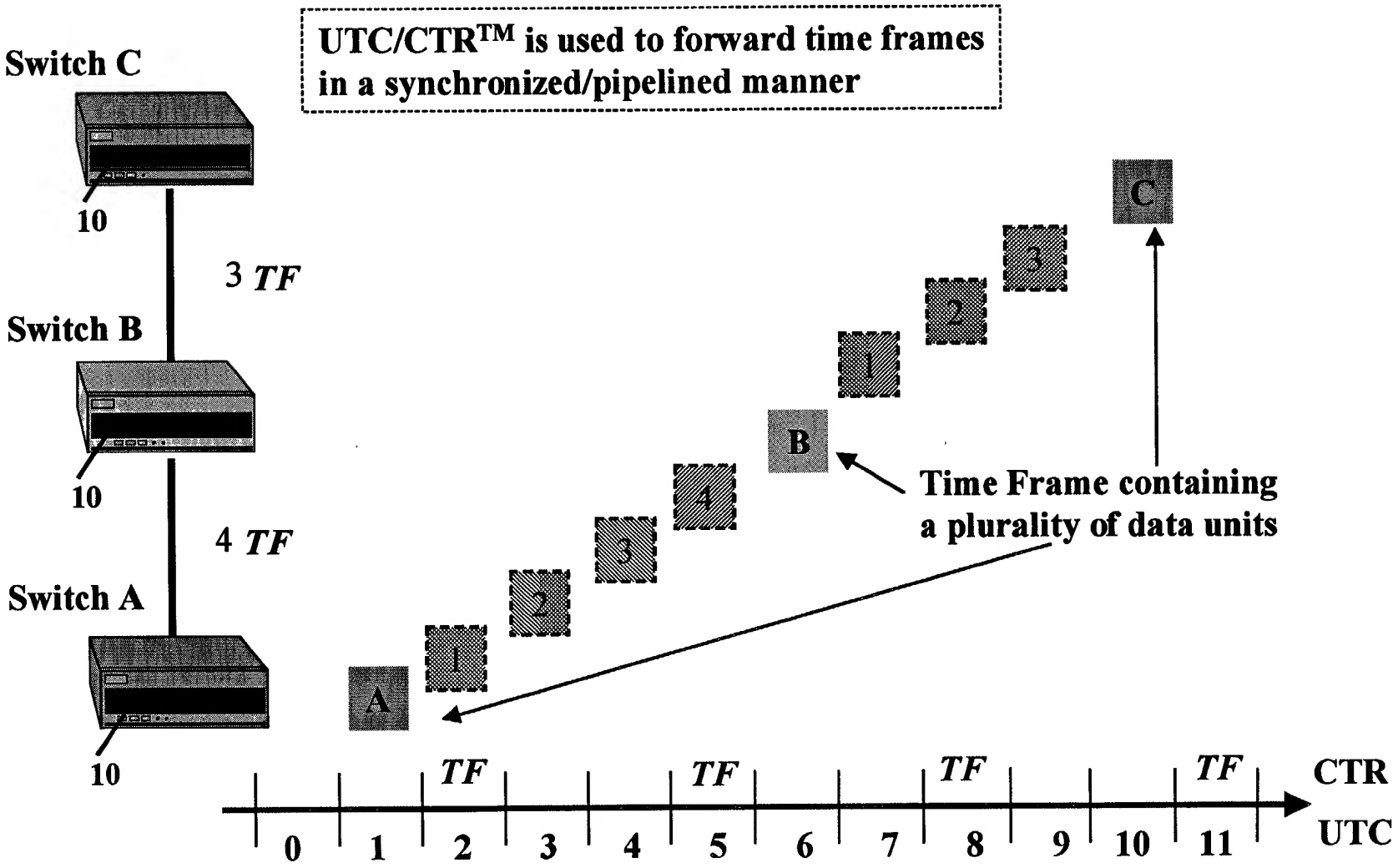
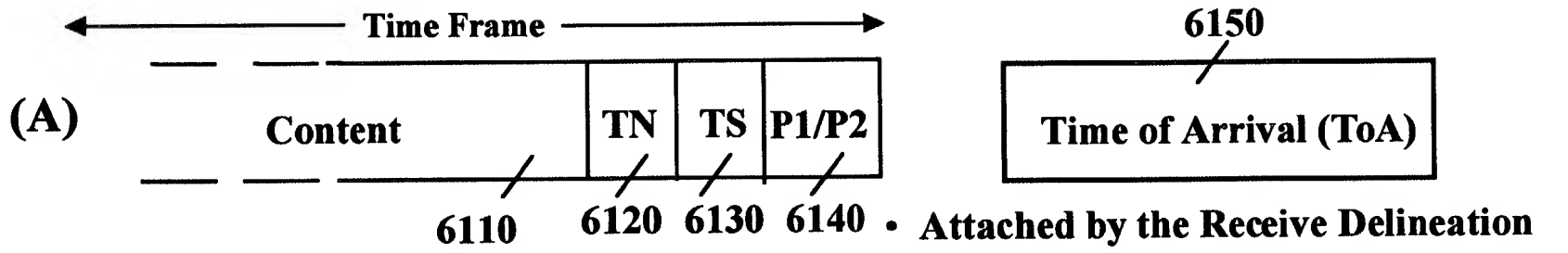

UTC/CTR™ is used to forward time frames in a synchronized/pipelined manner
Switch C
10
3 TF
Switch B
10
4 TF
Switch A
10
A
1
2
3
4
B
1
2
3
C
Time Frame containing a plurality of data units
TF
TF
TF
TF
CTR
UTC
0
1
2
3
4
5
6
7
8
9
10
11

FIG. 4



- Attached by the Receive Delineation Controller
- The TOA represents the instant value of the common time reference 002 when the time frame is received

(B) P1/P2

P1/P2=00 D-frame - Time frame delimiter
P1/P2=01 D-cycle - Time cycle delimiter
P1/P2=10 D-control - Control time frame delimiter

TN - Time frame number
TS - Time stamp

FIG. 5

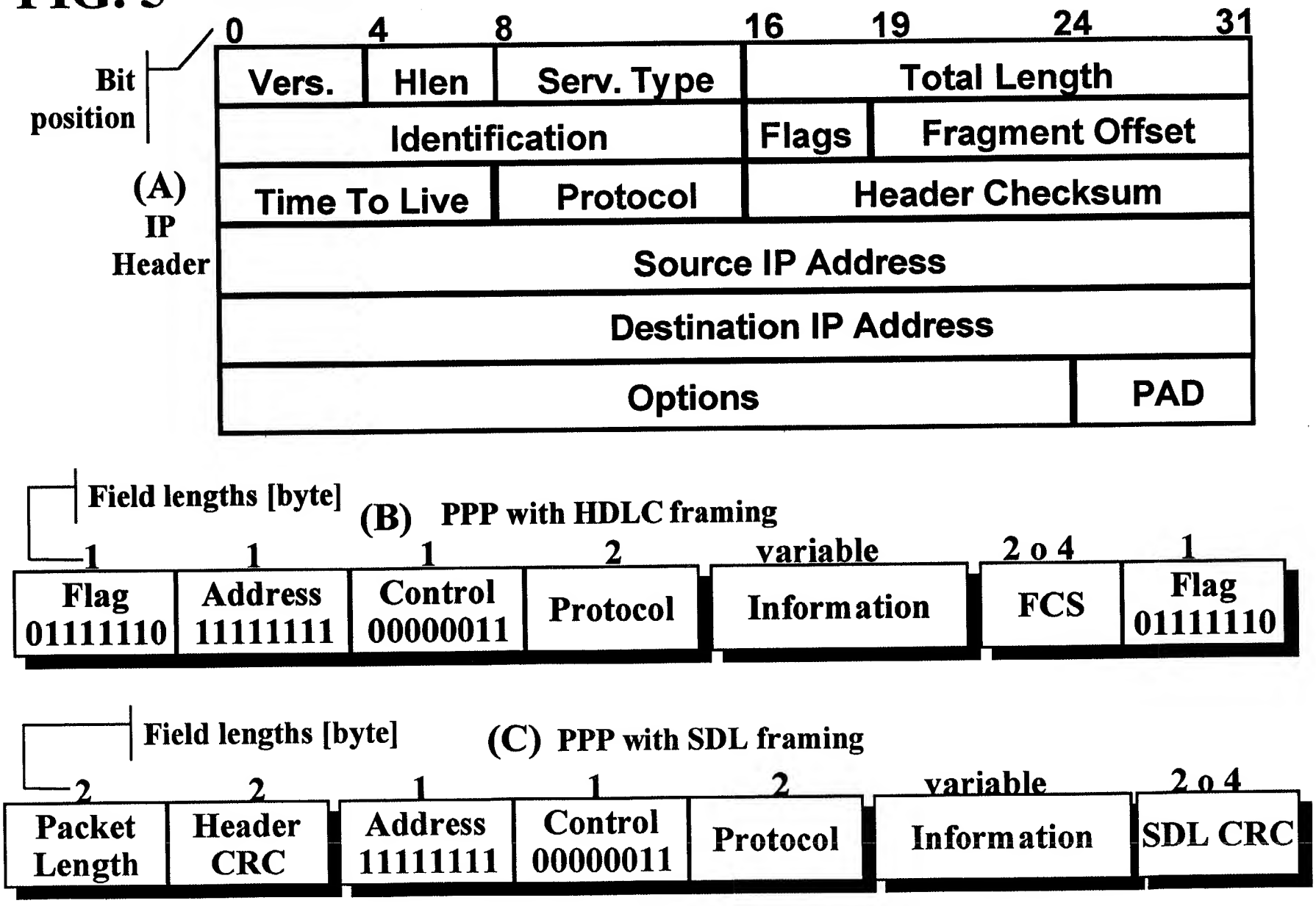

Bit position
0
4
8
16
19
24
31
Vers.
Hlen
Serv. Type
Total Length
Identification
Flags
Fragment Offset
Time To Live
Protocol
Header Checksum
Source IP Address
Destination IP Address
Options
PAD
(A) IP Header
Field lengths [byte]
(B) PPP with HDLC framing
1
1
1
2
variable
2 o 4
1
Flag 01111110
Address 11111111
Control 00000011
Protocol
Information
FCS
Flag 01111110
Field lengths [byte]
(C) PPP with SDL framing
2
2
1
1
2
variable
2 o 4
Packet Length
Header CRC
Address 11111111
Control 00000011
Protocol
Information
SDL CRC

FIG. 6

- SONET - synchronous optical network
- Multiplexing method: byte interleaving
- Signal hierarchy: OC-N (STS-N)
  - STS-N rate: N*51.84 Mb/s
  - Frame format: 9 rows by 90*N columns
    - capacity: N*810 bytes in 125 microsecond.
    - overhead: N*27 bytes
    - payload: N*783 bytes

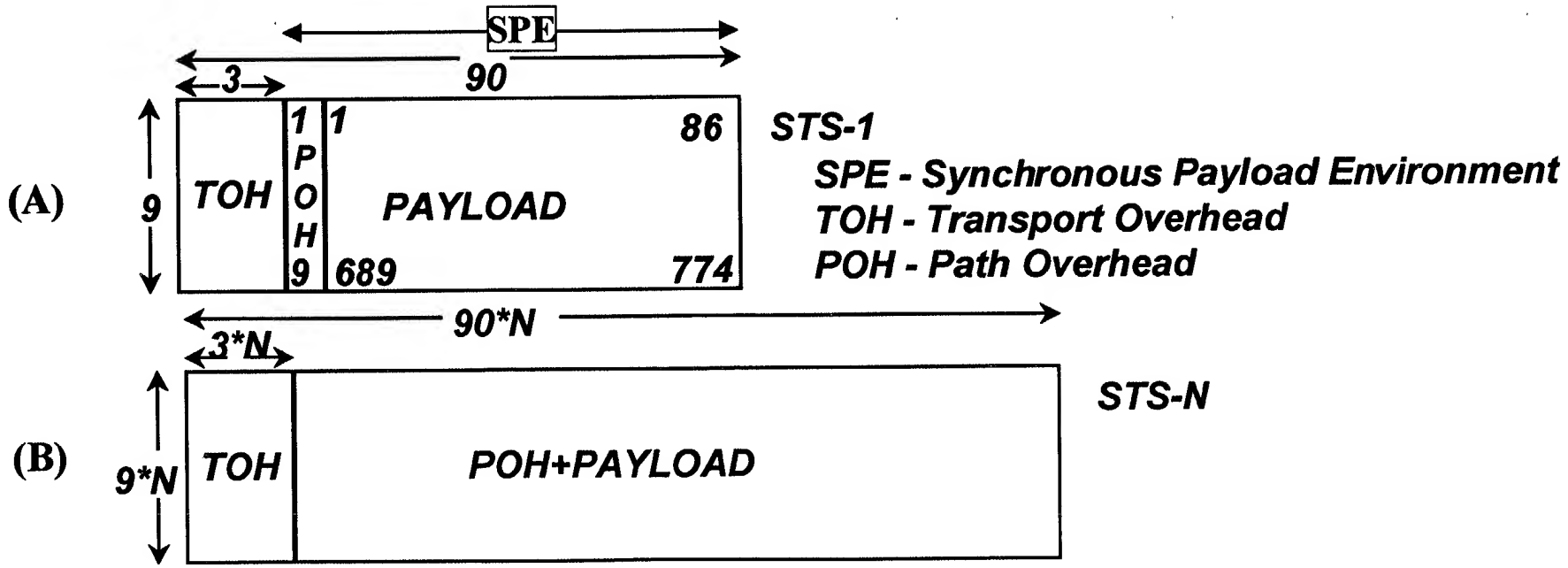


FIG. 7

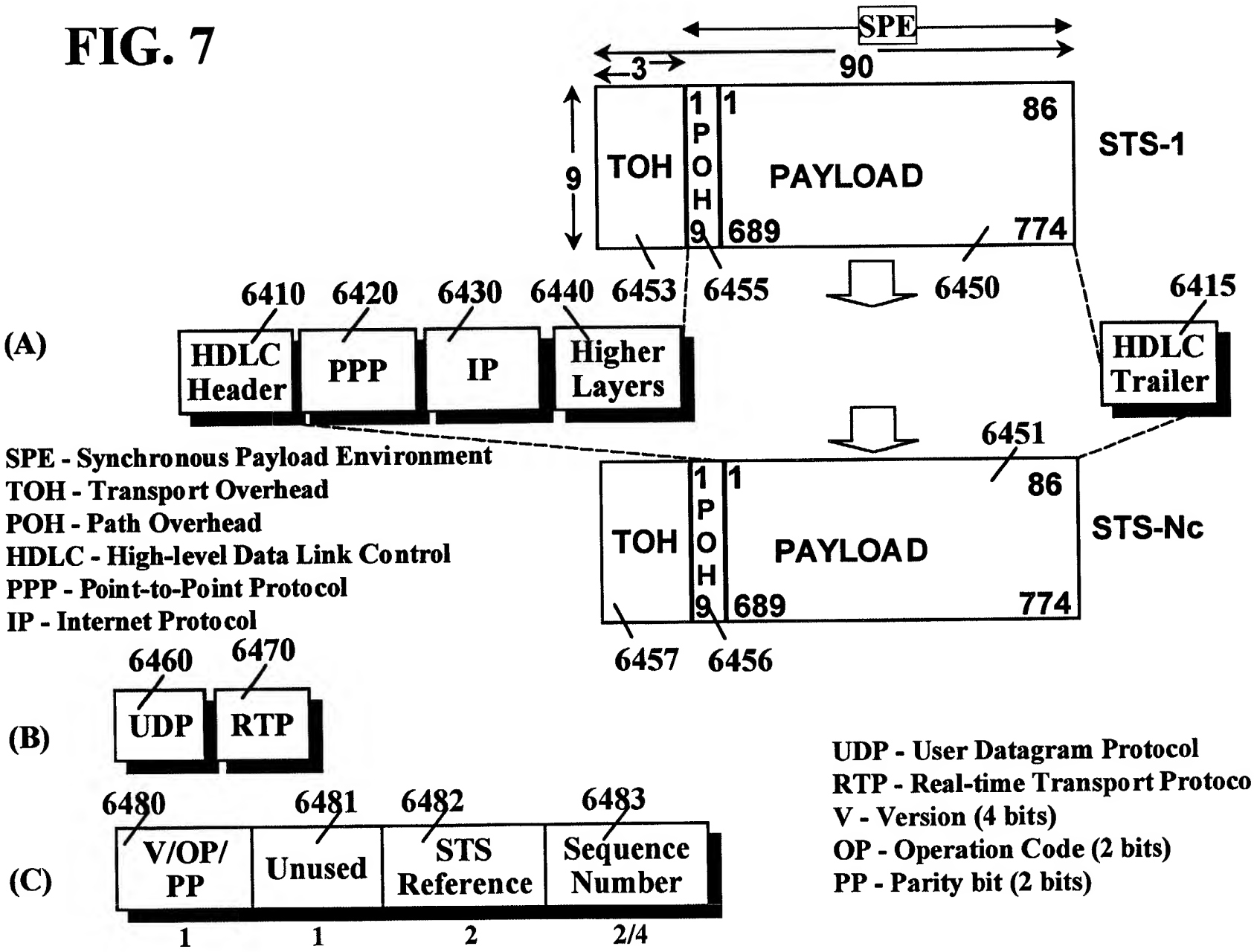
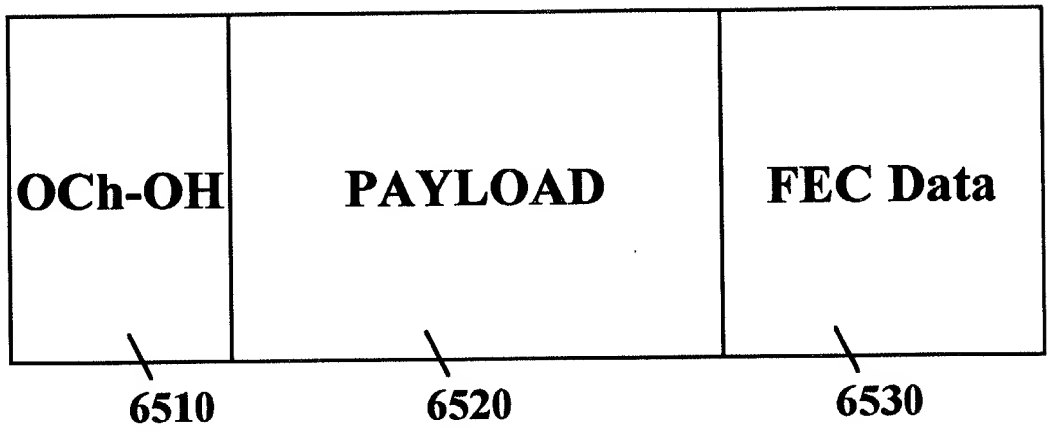


FIG. 8



OCh - Optical Channel
OH - Overhead
FEC - Forward Error Correction

FIG. 9

***TF Alignment of* UTR(j) *to* UTC -** with three input queues - principle of operation:
The same queue is not used simultaneously for:
1. Receiving data packets from the serial link, and
2. Forwarding data packets to the switch fabric

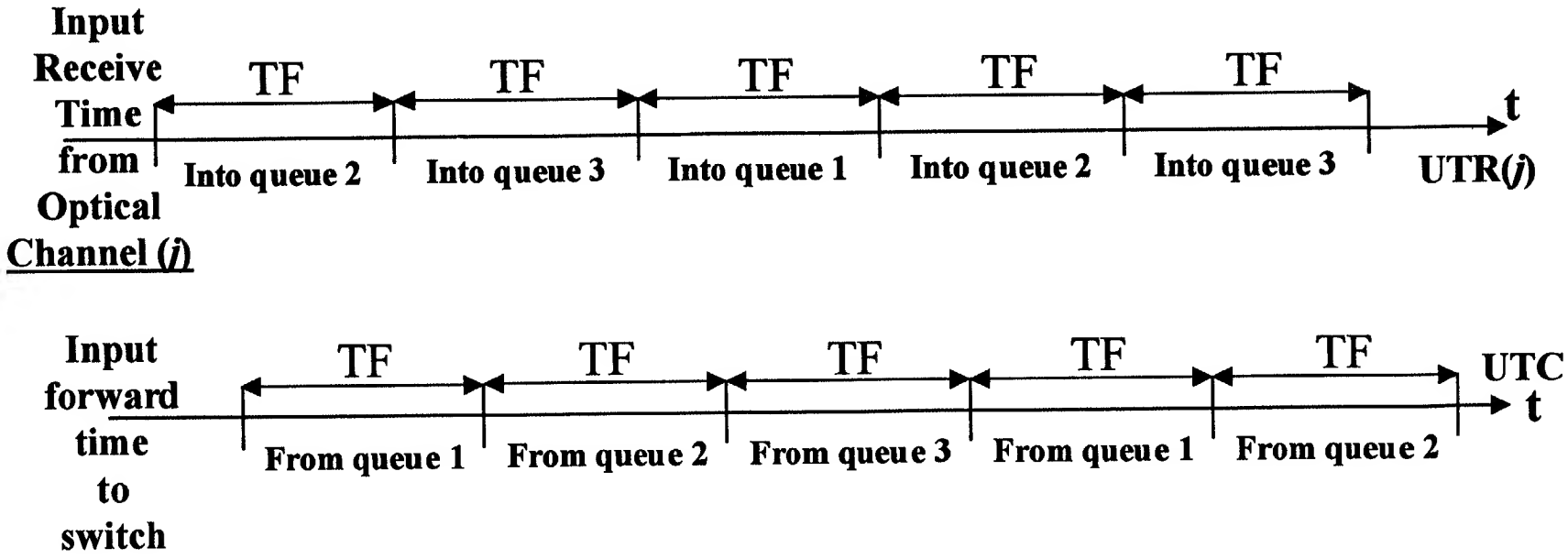
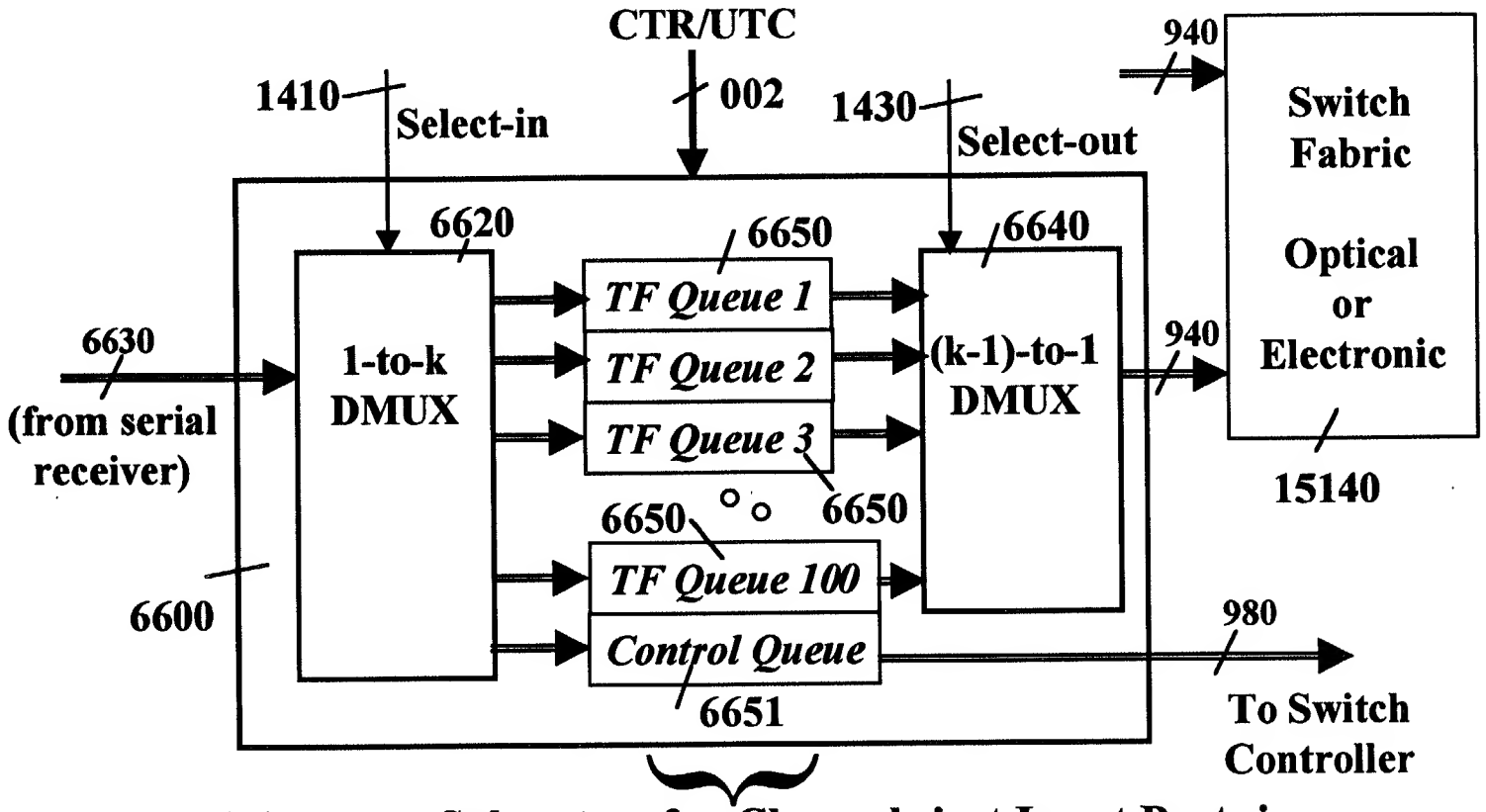


FIG. 10



Alignment Subsystem for Channel *j* at Input Port *i*
with a Plurality of k Time Frame Queues, where k is the number of time frames in one time cycle

FIG. 11

Maximum alignment subsystem requirements for
local recovery from **arbitrary timing failure**:
- *For immediate recovery a time measurement time stamp should be sent every time frame and/or time cycle.*

Time Cycle	OC-48 – 2.4 Gb/s	OC-192 – 9.6 Gb/s
1 ms	0.3 MByte	1.2 MByte
2 ms	0.6 MByte	2.4 MByte
4 ms	1.2 MByte	4.8 MByte
10 ms	3 MByte	12 MByte
20 ms	6MByte	24 MByte

FIG. 12

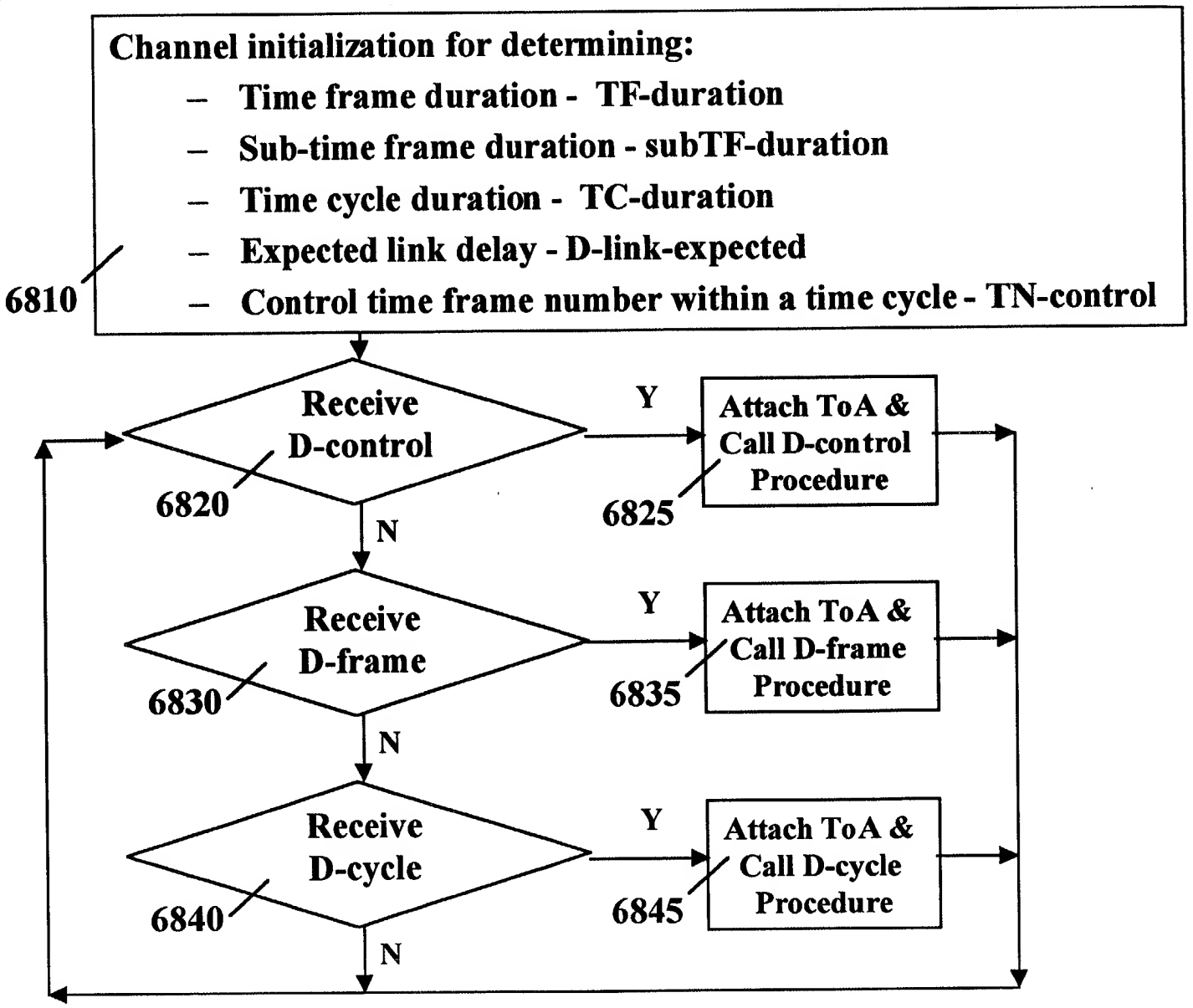

Channel initialization for determining:
– Time frame duration - TF-duration
– Sub-time frame duration - subTF-duration
– Time cycle duration - TC-duration
– Expected link delay - D-link-expected
– Control time frame number within a time cycle - TN-control
6810
Receive D-control
6820
Y
Attach ToA & Call D-control Procedure
6825
N
Receive D-frame
6830
Y
Attach ToA & Call D-frame Procedure
6835
N
Receive D-cycle
6840
Y
Attach ToA & Call D-cycle Procedure
6845
N

FIG. 13

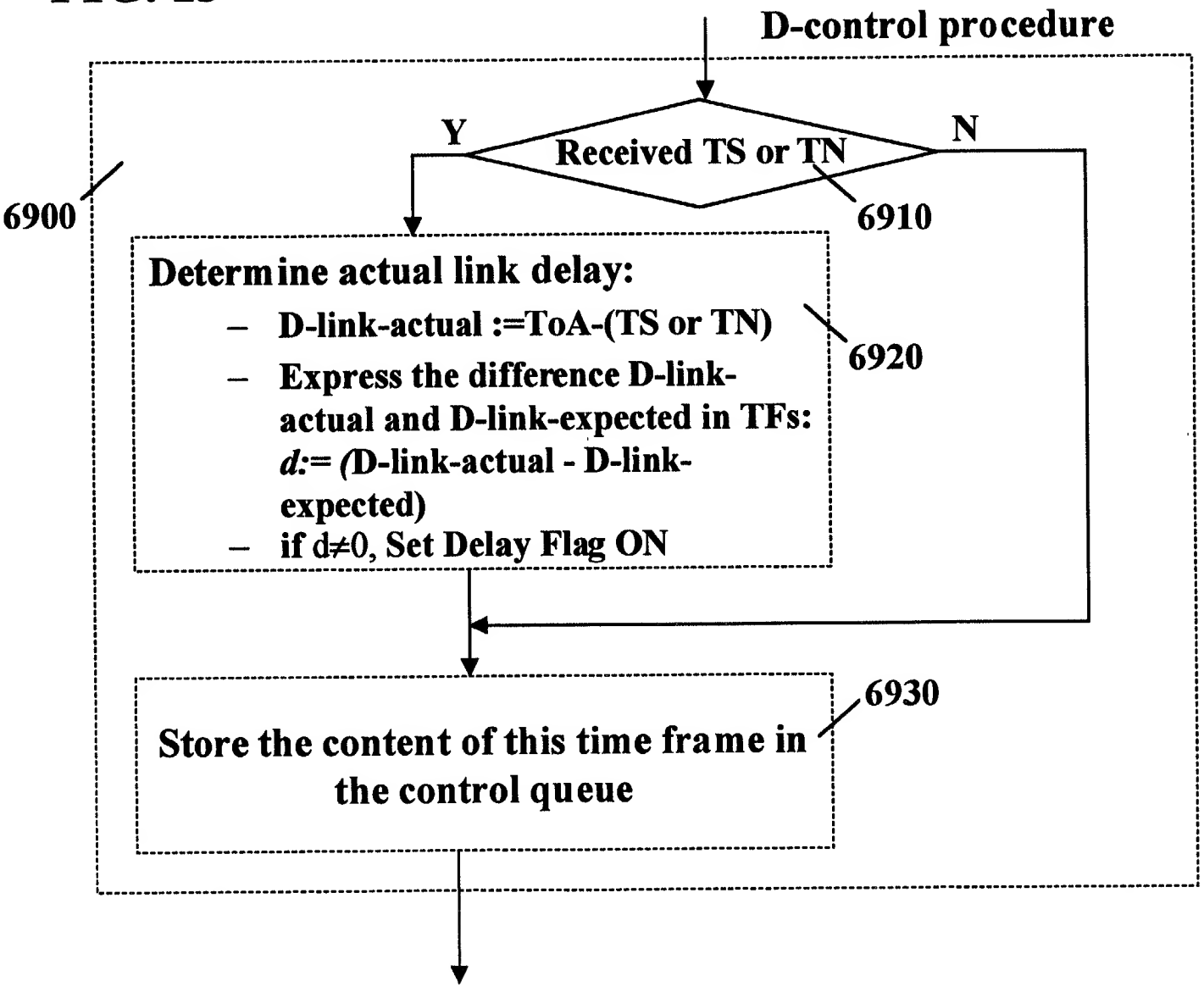


FIG. 14

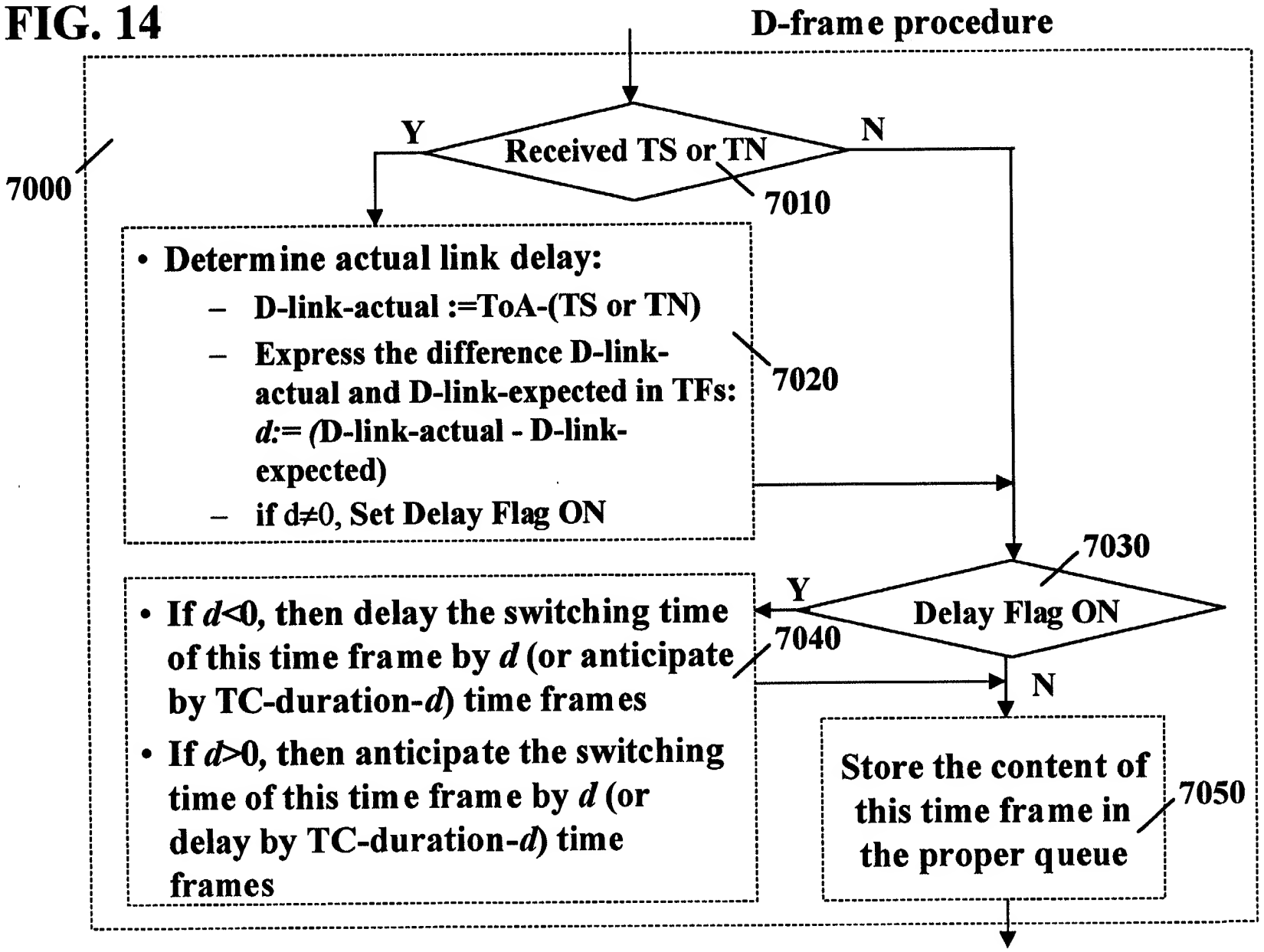


FIG. 15

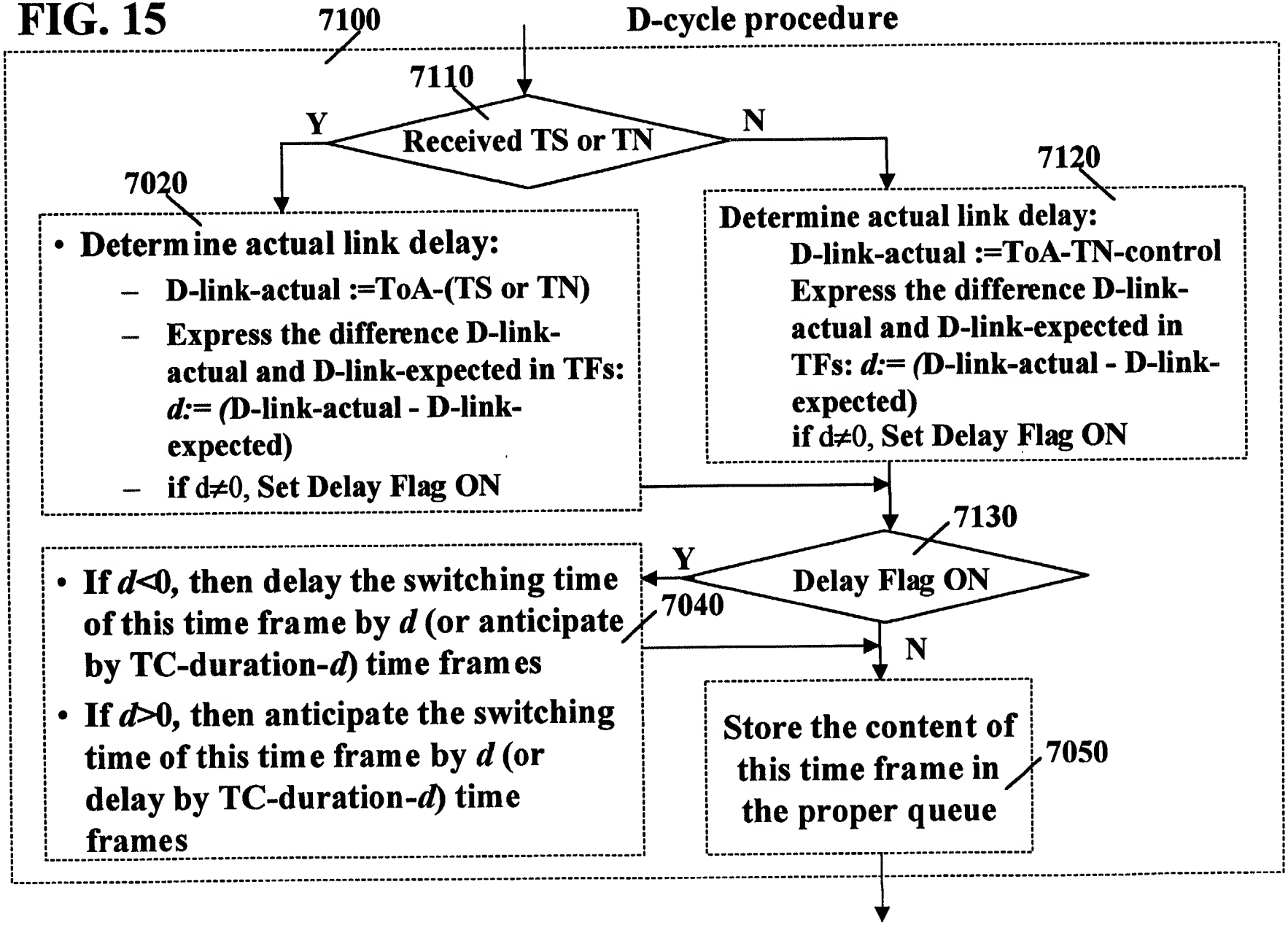


FIG. 16

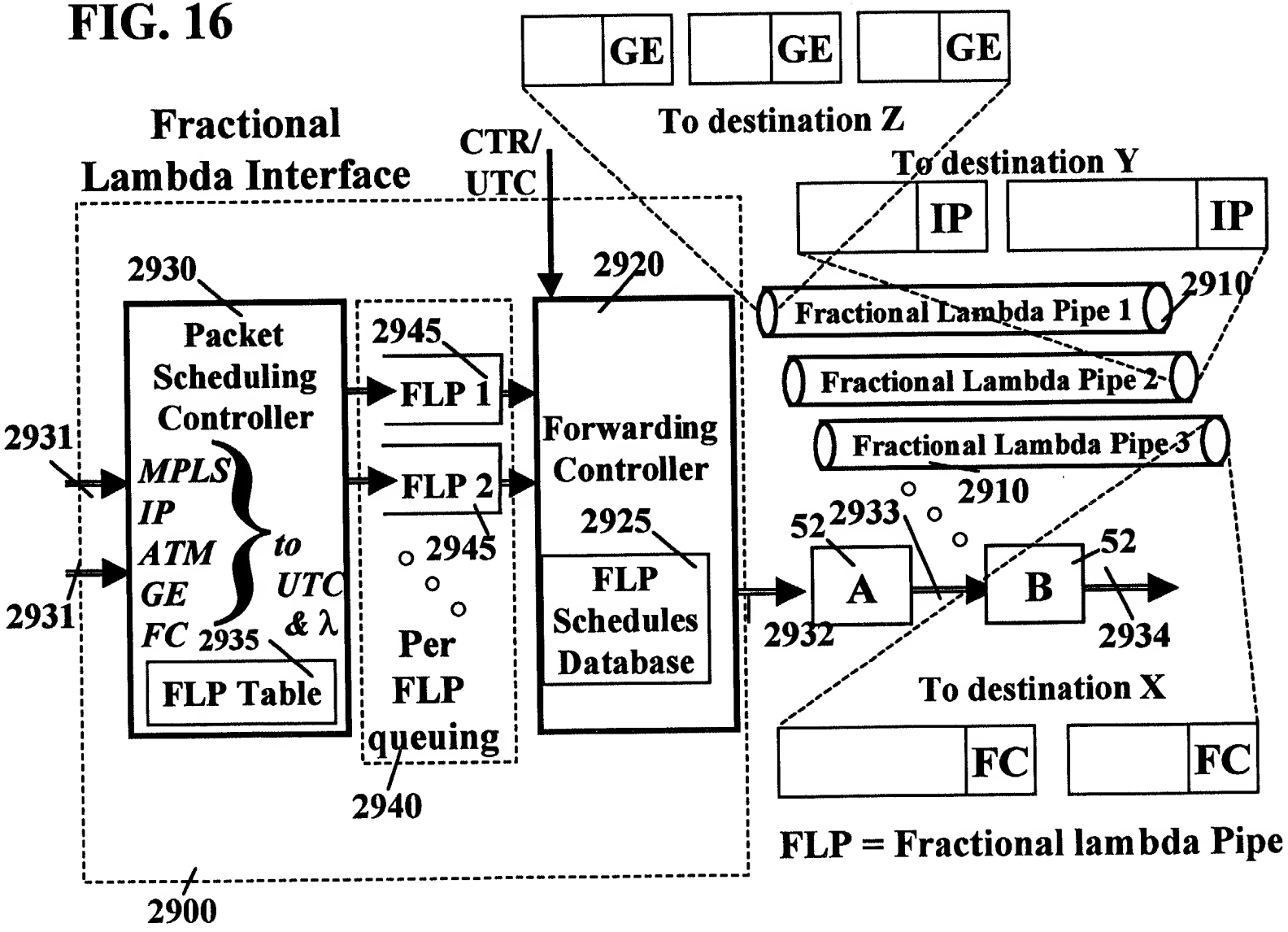


FIG. 17

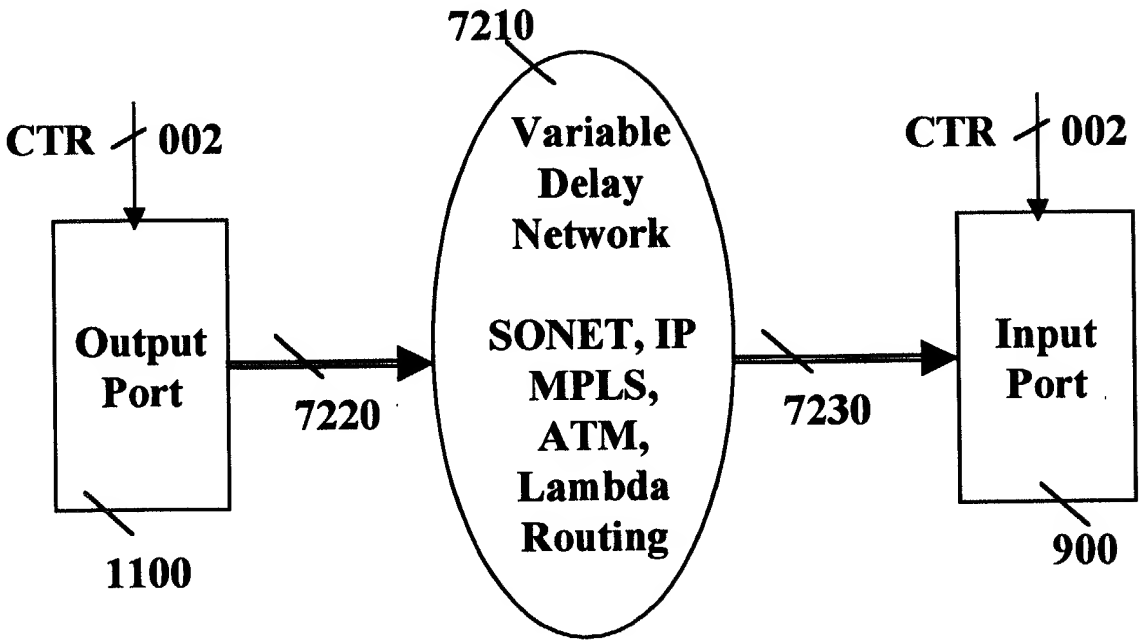


FIG. 18

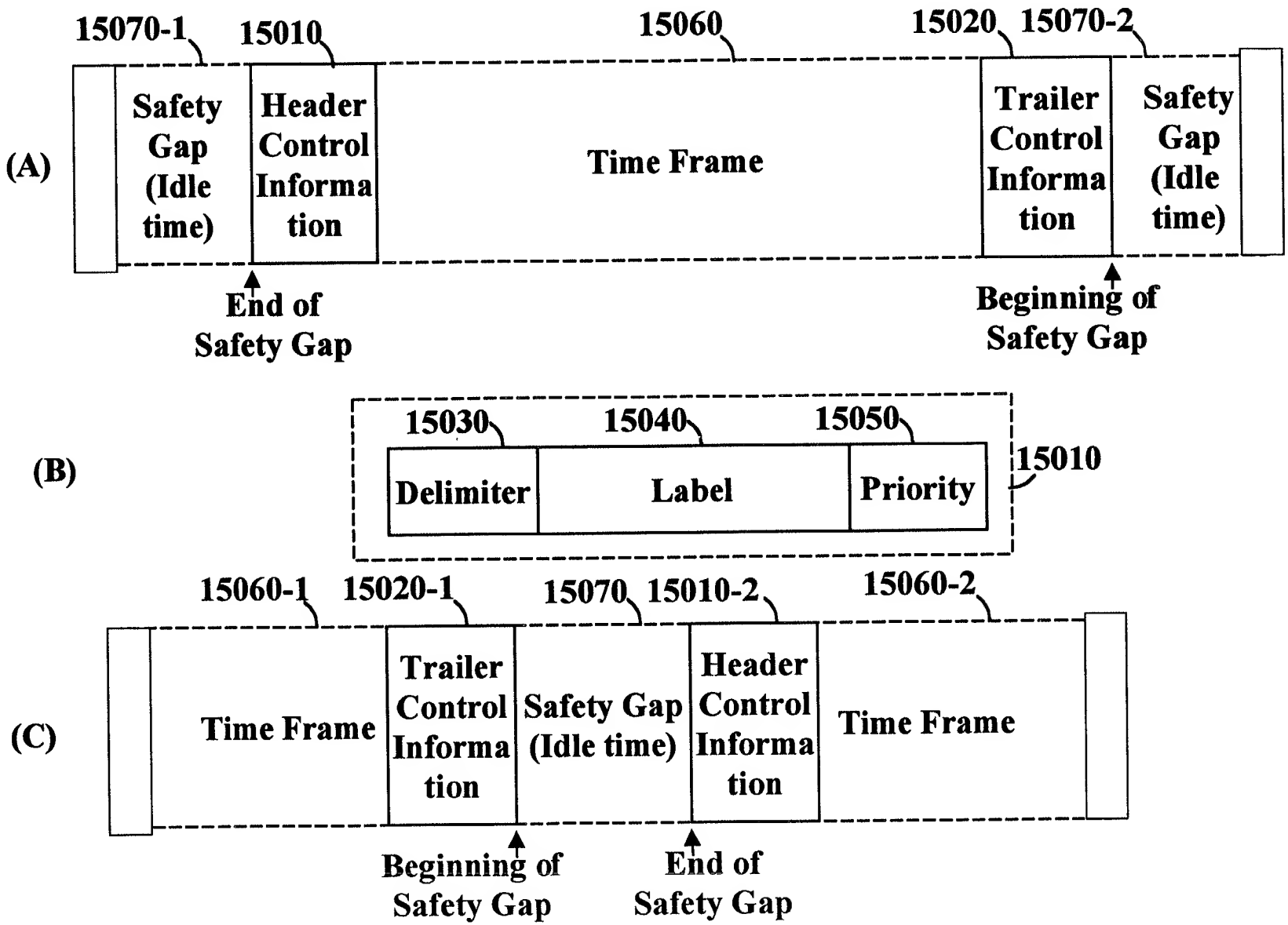


FIG. 19

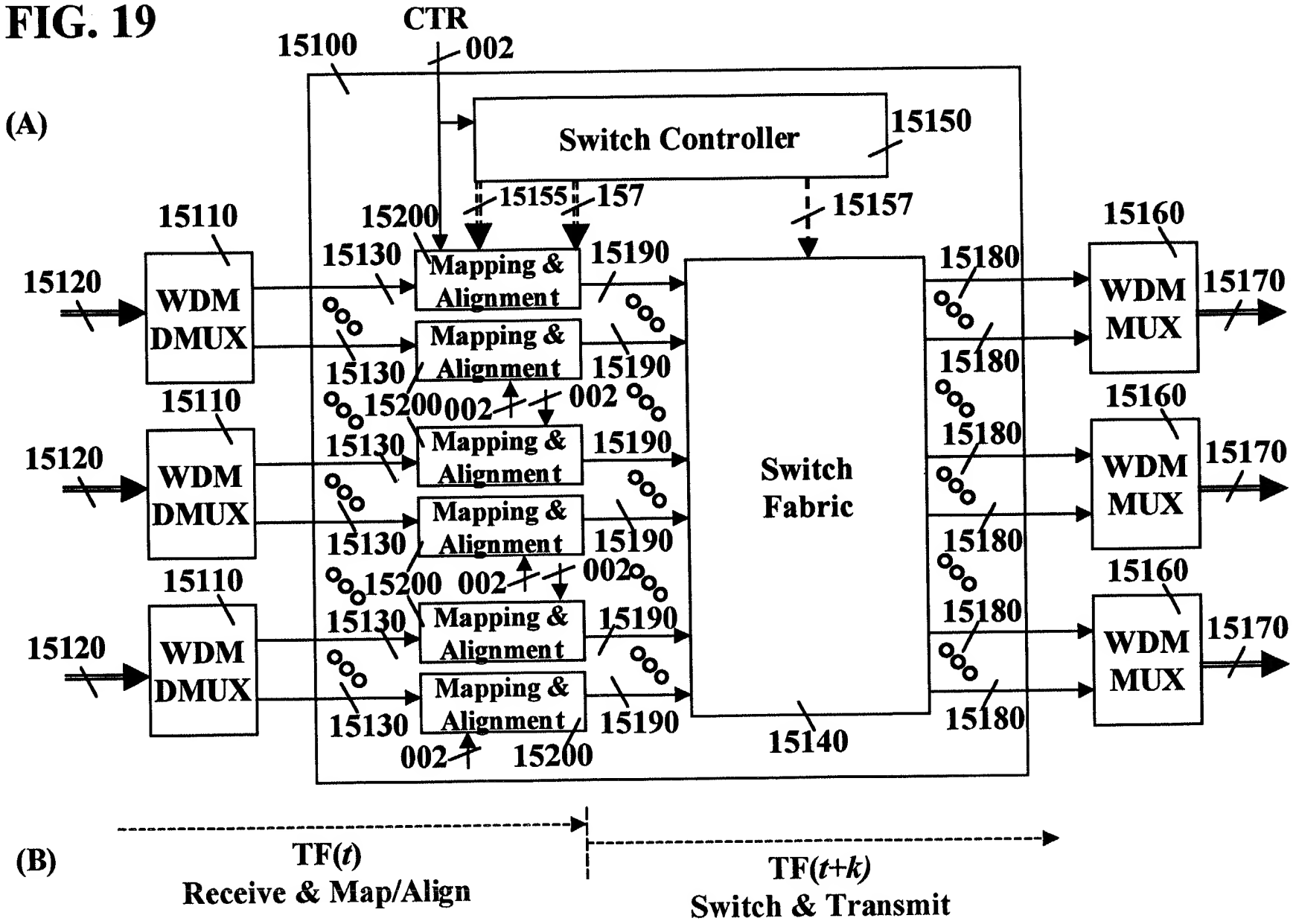


FIG. 20

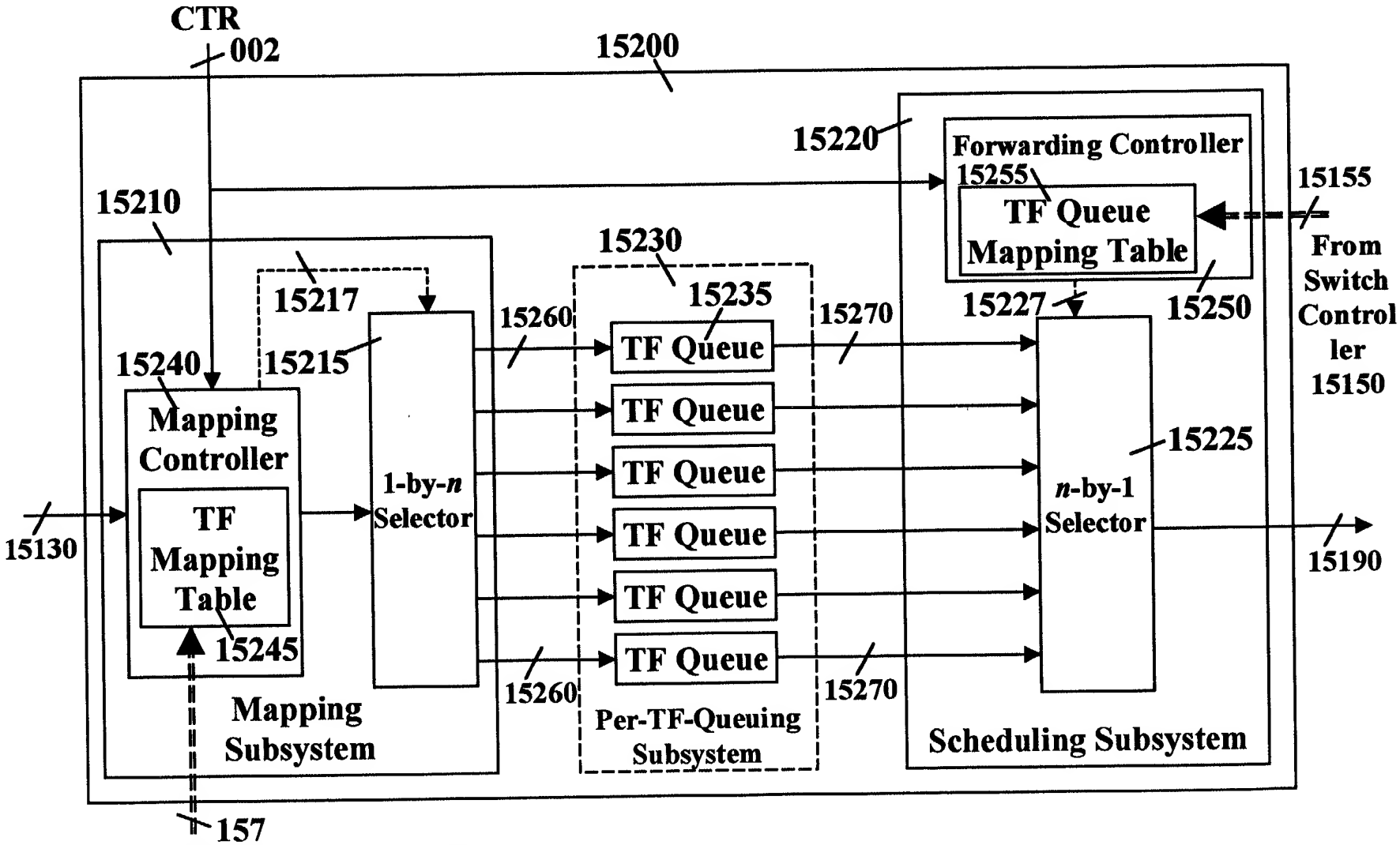


FIG. 21

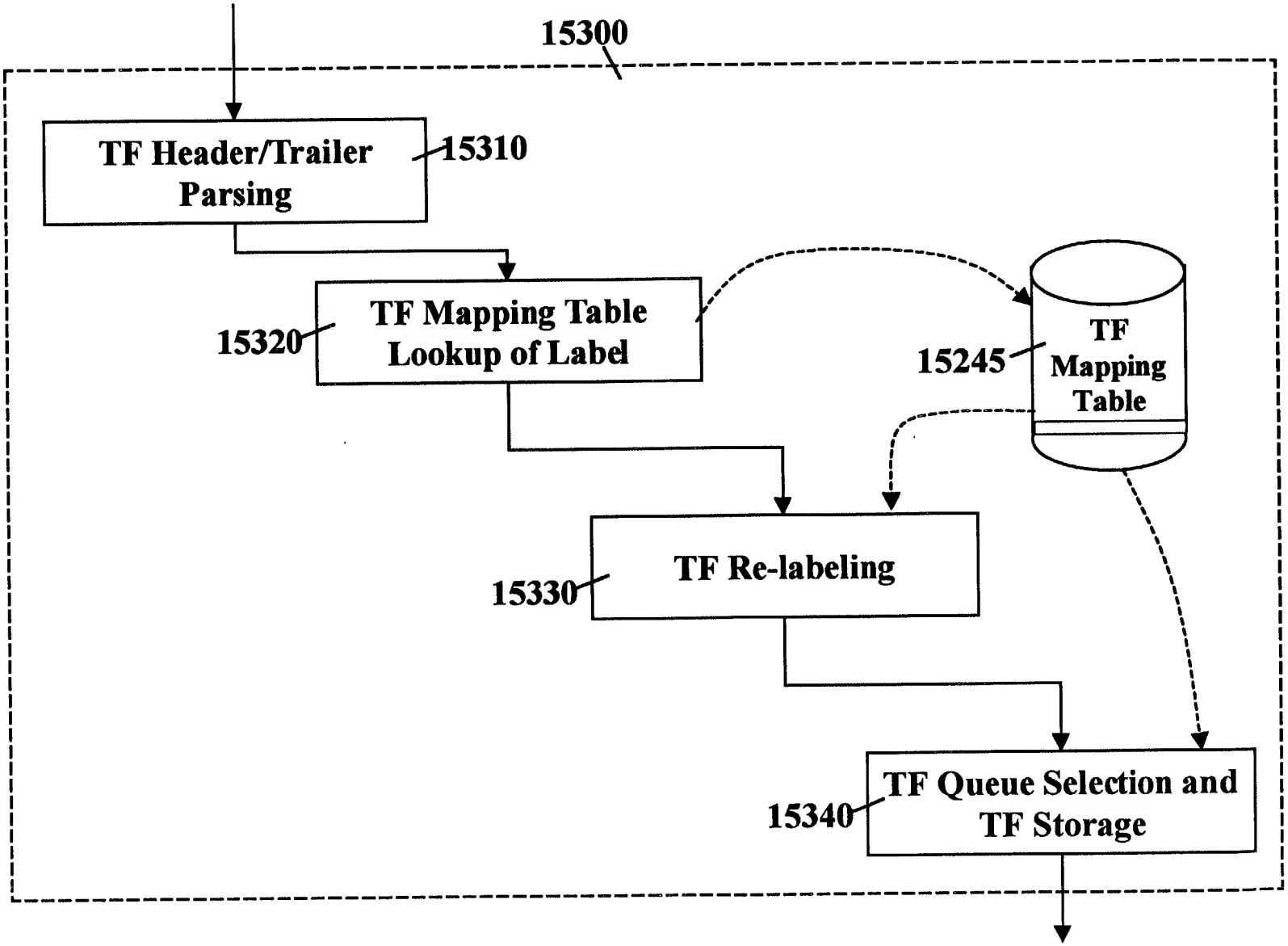


FIG. 22

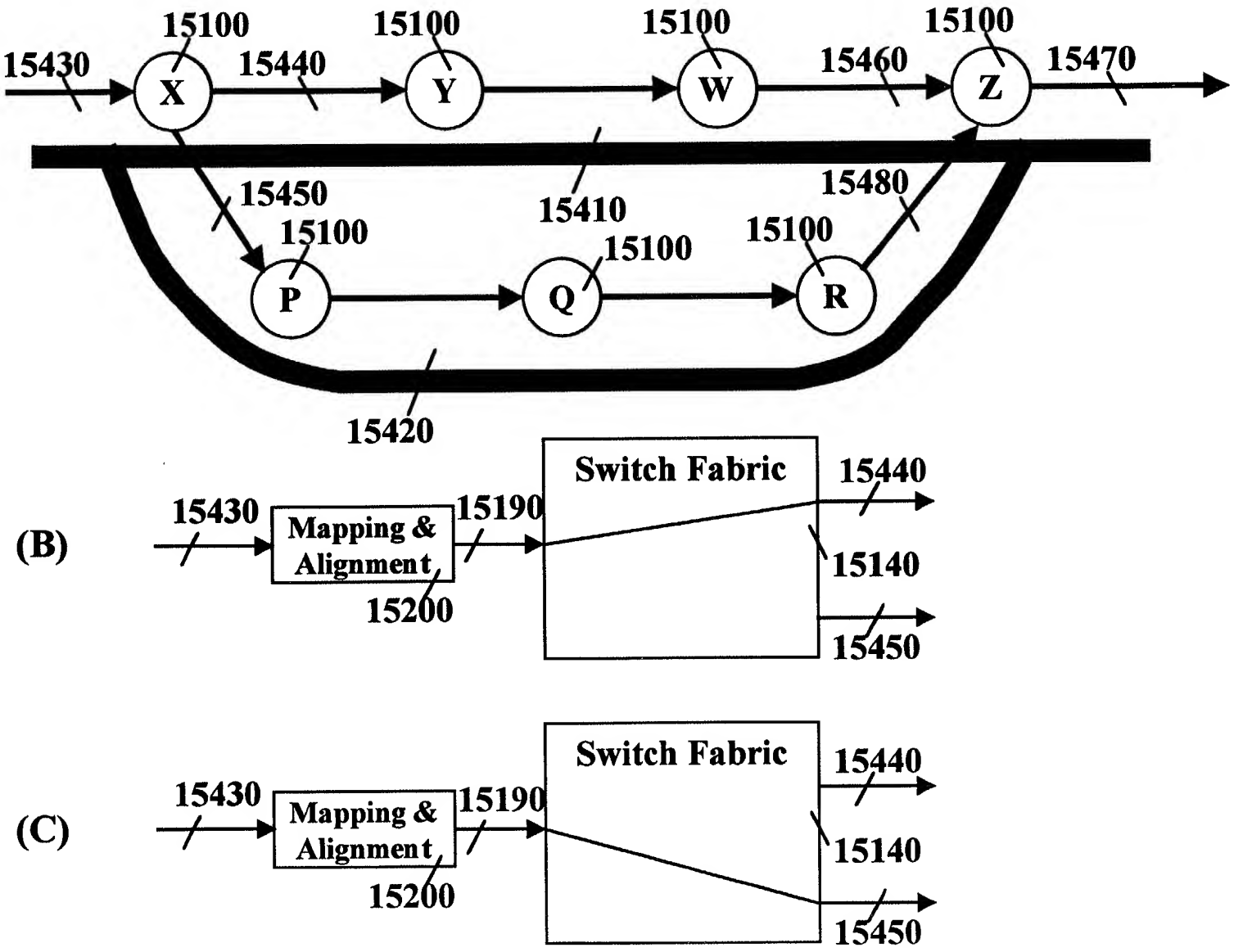


FIG. 23

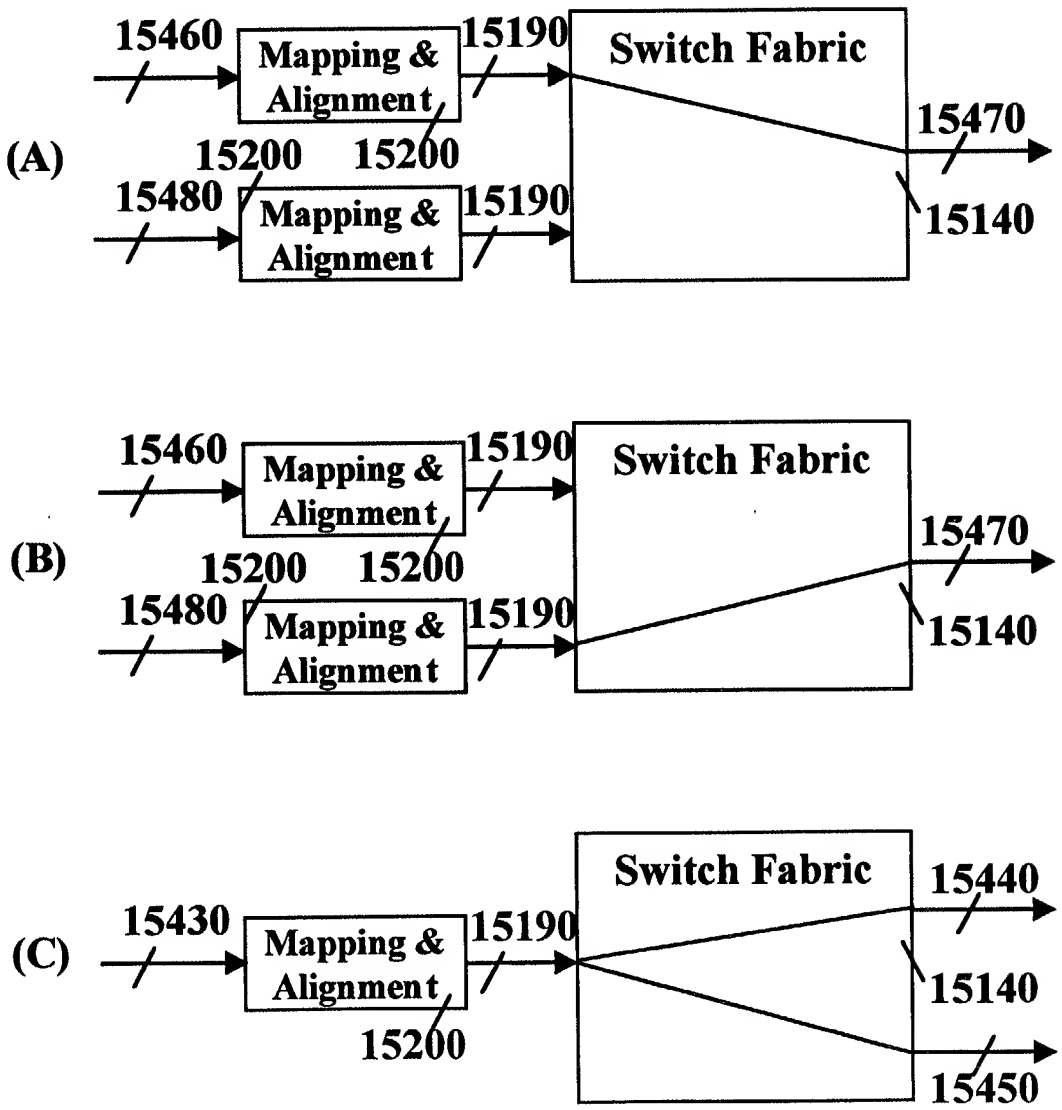


FIG. 24

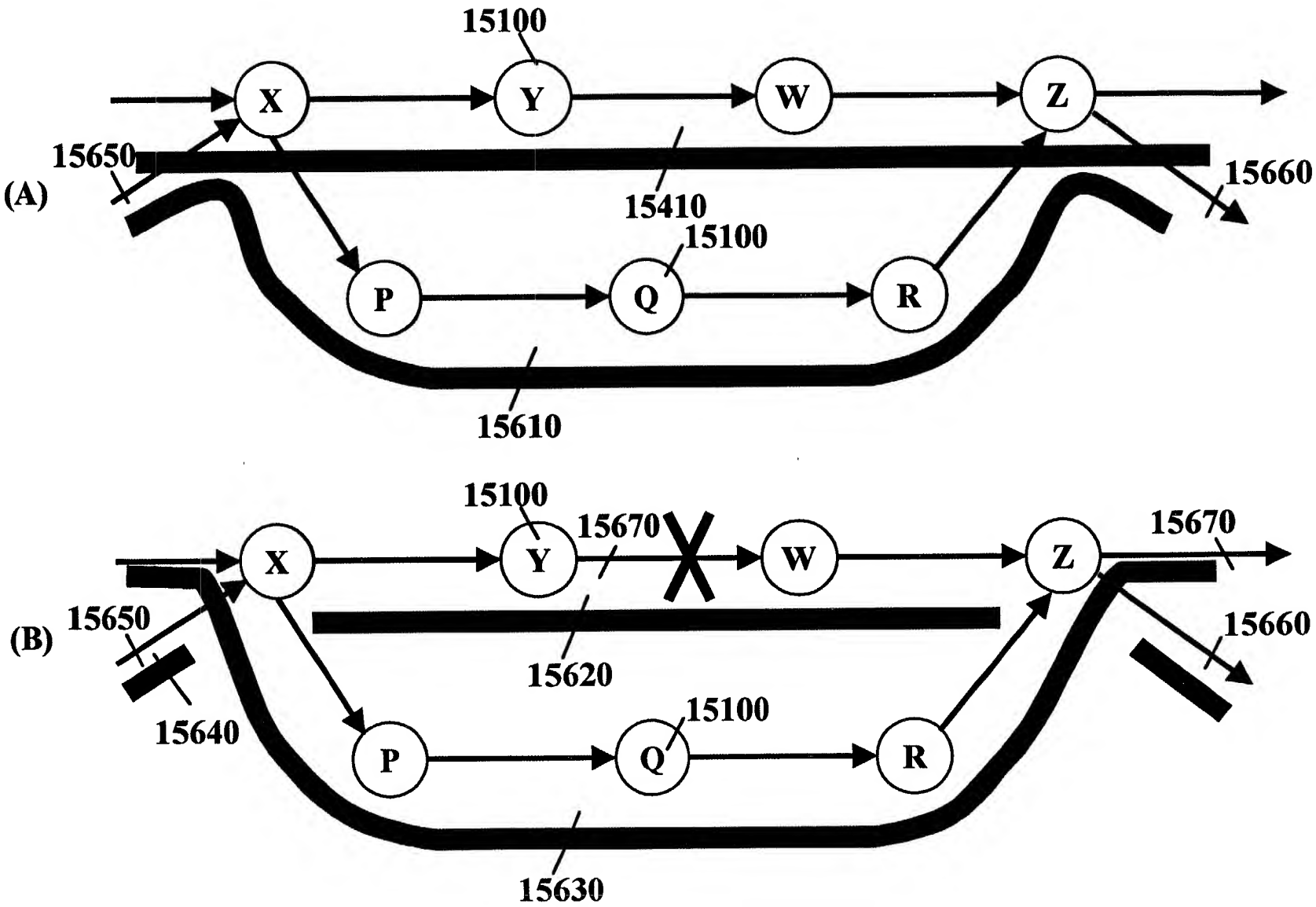


FIG. 25

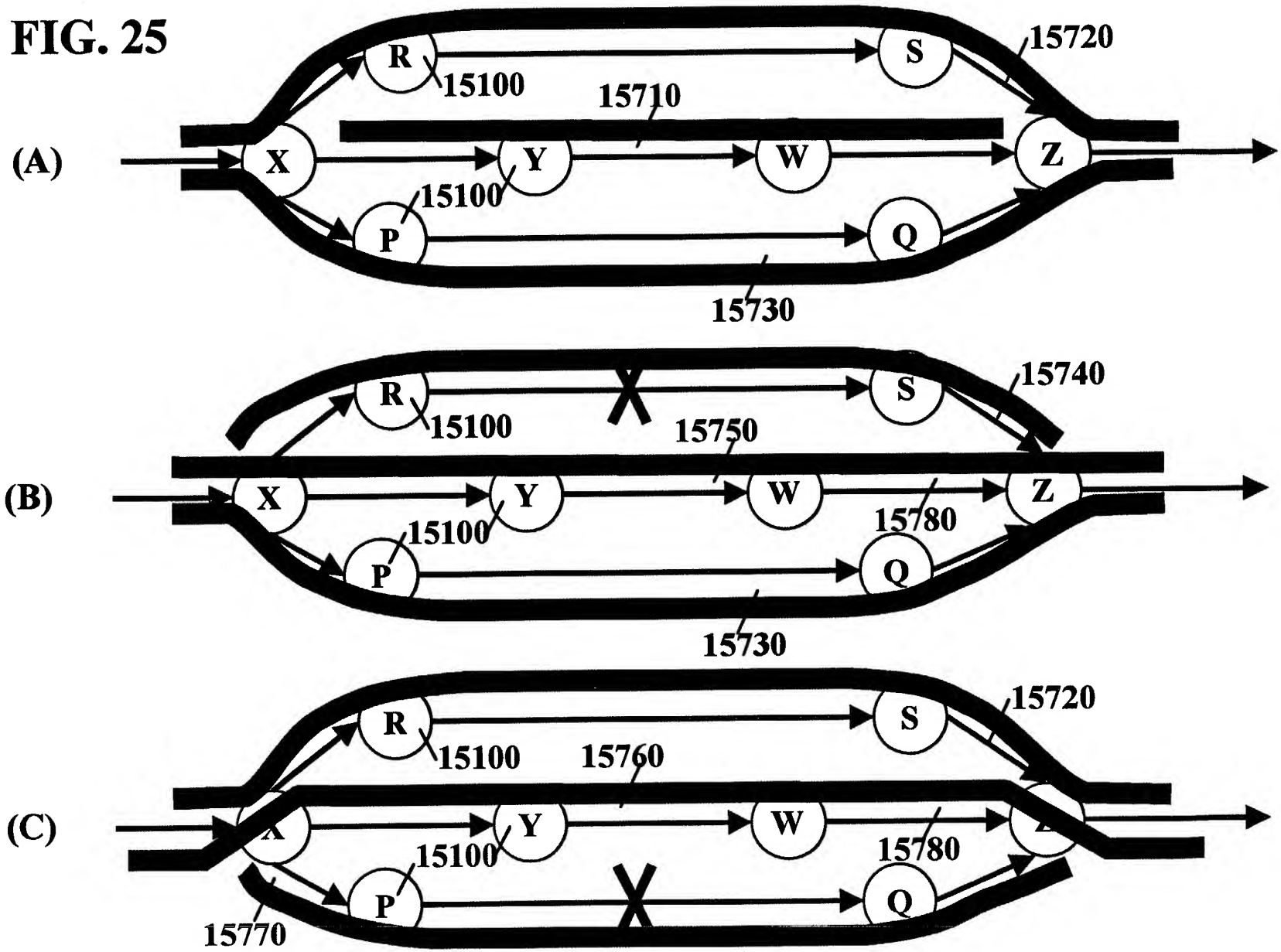


FIG. 26

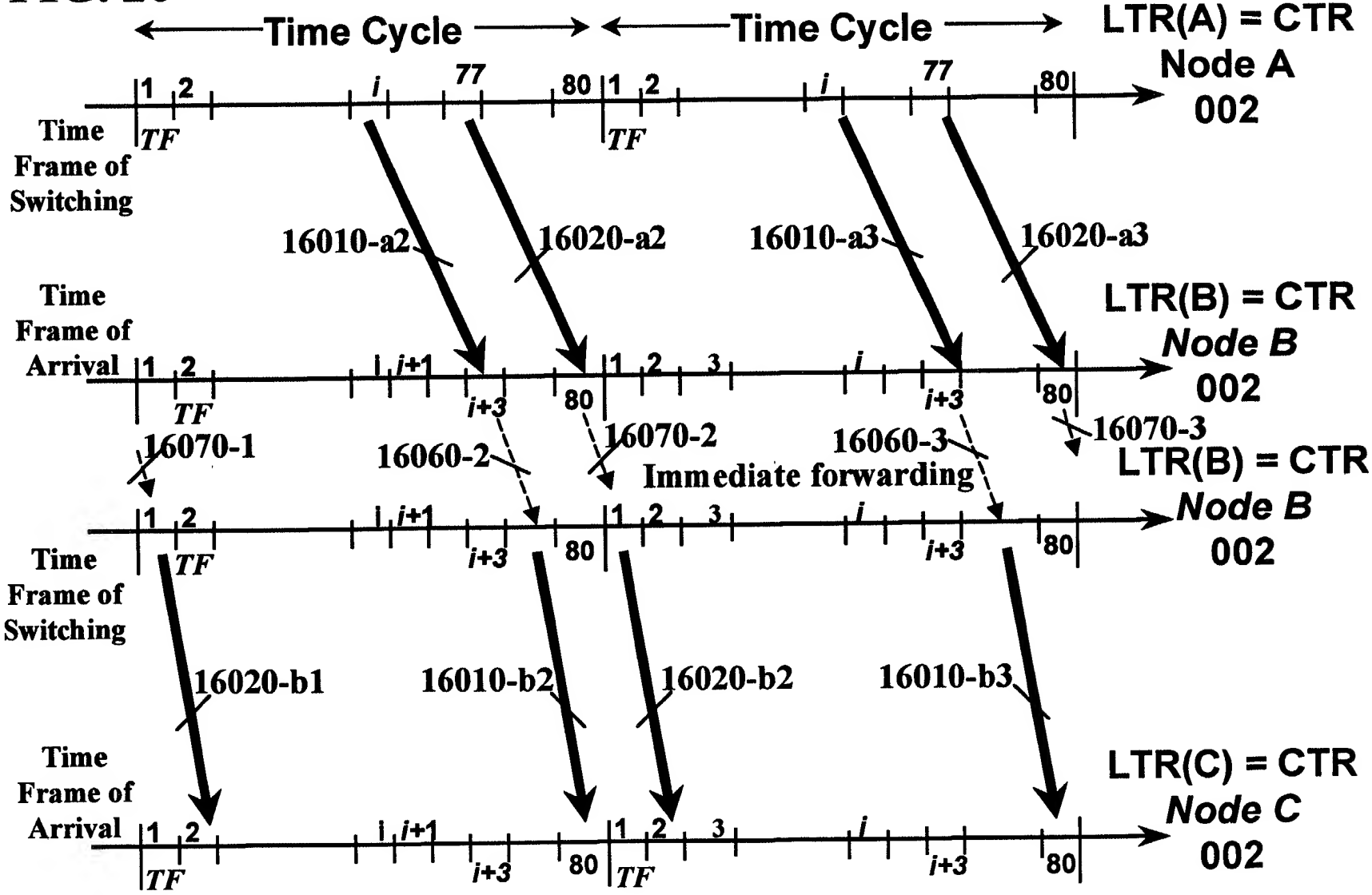


FIG. 27

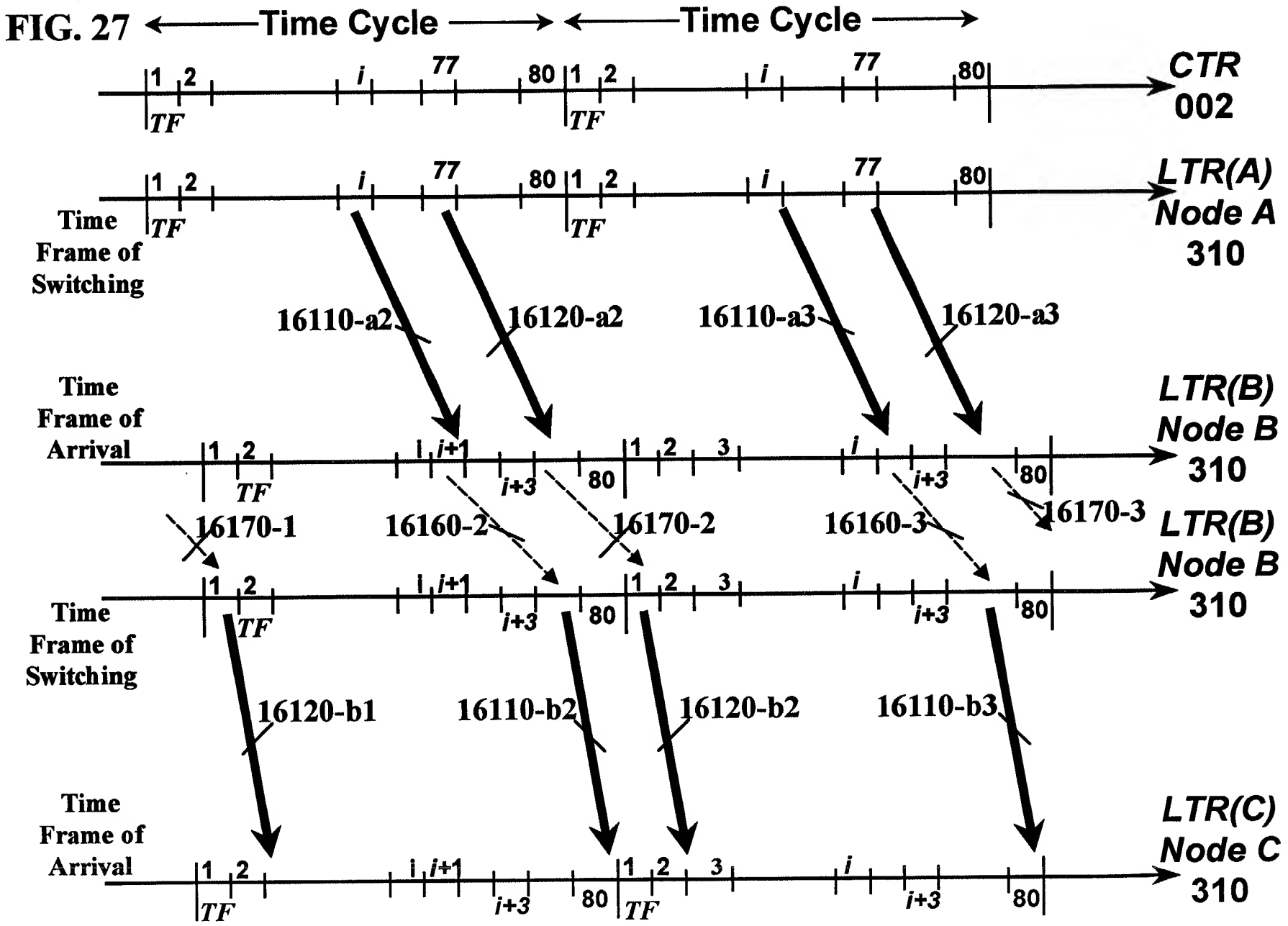


FIG. 28

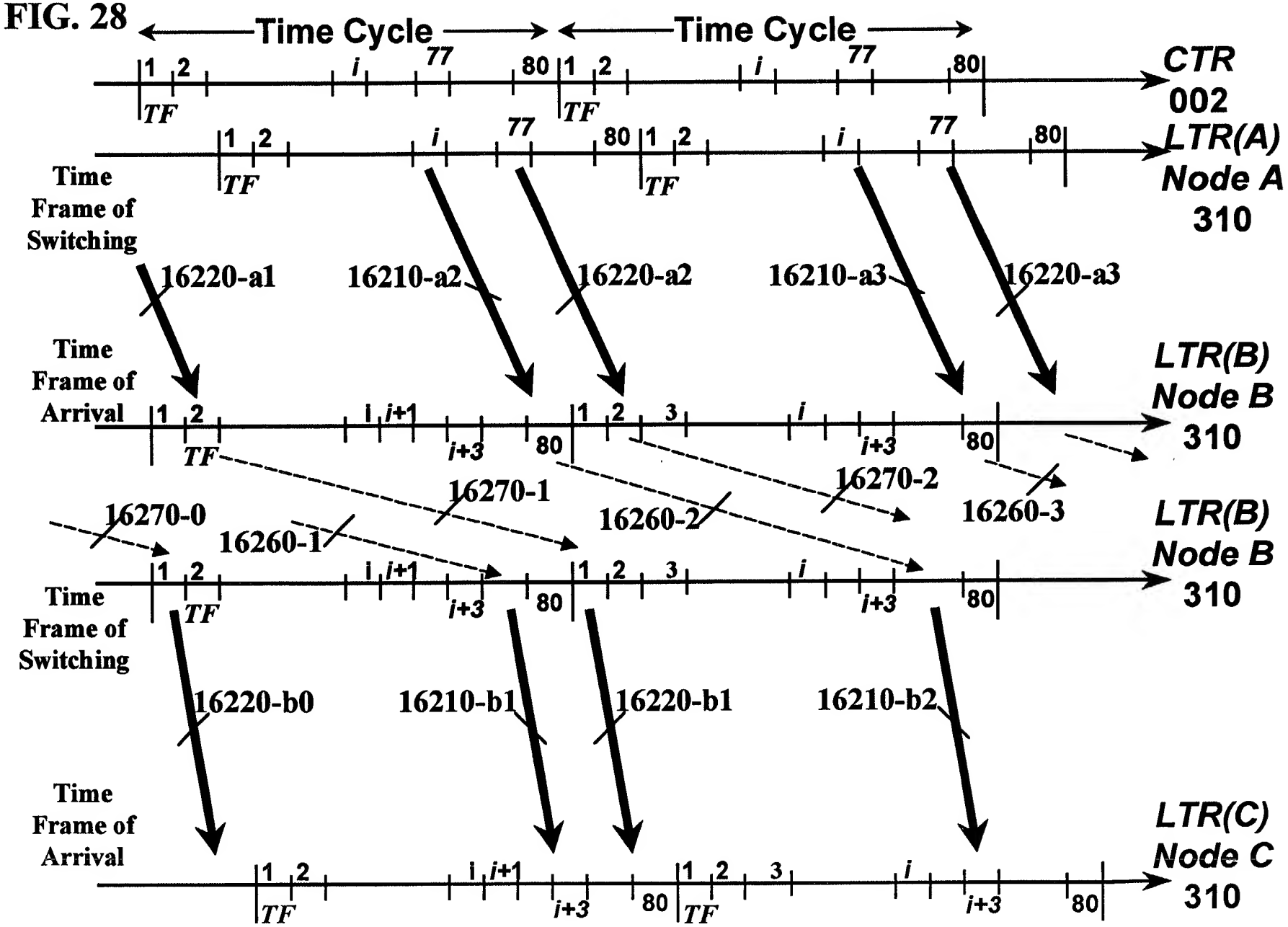

Time Cycle
Time Cycle
CTR 002
LTR(A) Node A 310
Time Frame of Switching
16220-a1
16210-a2
16220-a2
16210-a3
16220-a3
Time Frame of Arrival
LTR(B) Node B 310
16270-0
16260-1
16270-1
16260-2
16270-2
16260-3
LTR(B) Node B 310
Time Frame of Switching
16220-b0
16210-b1
16220-b1
16210-b2
Time Frame of Arrival
LTR(C) Node C 310
TF
i
i+1
i+3
77
80

FIG. 29

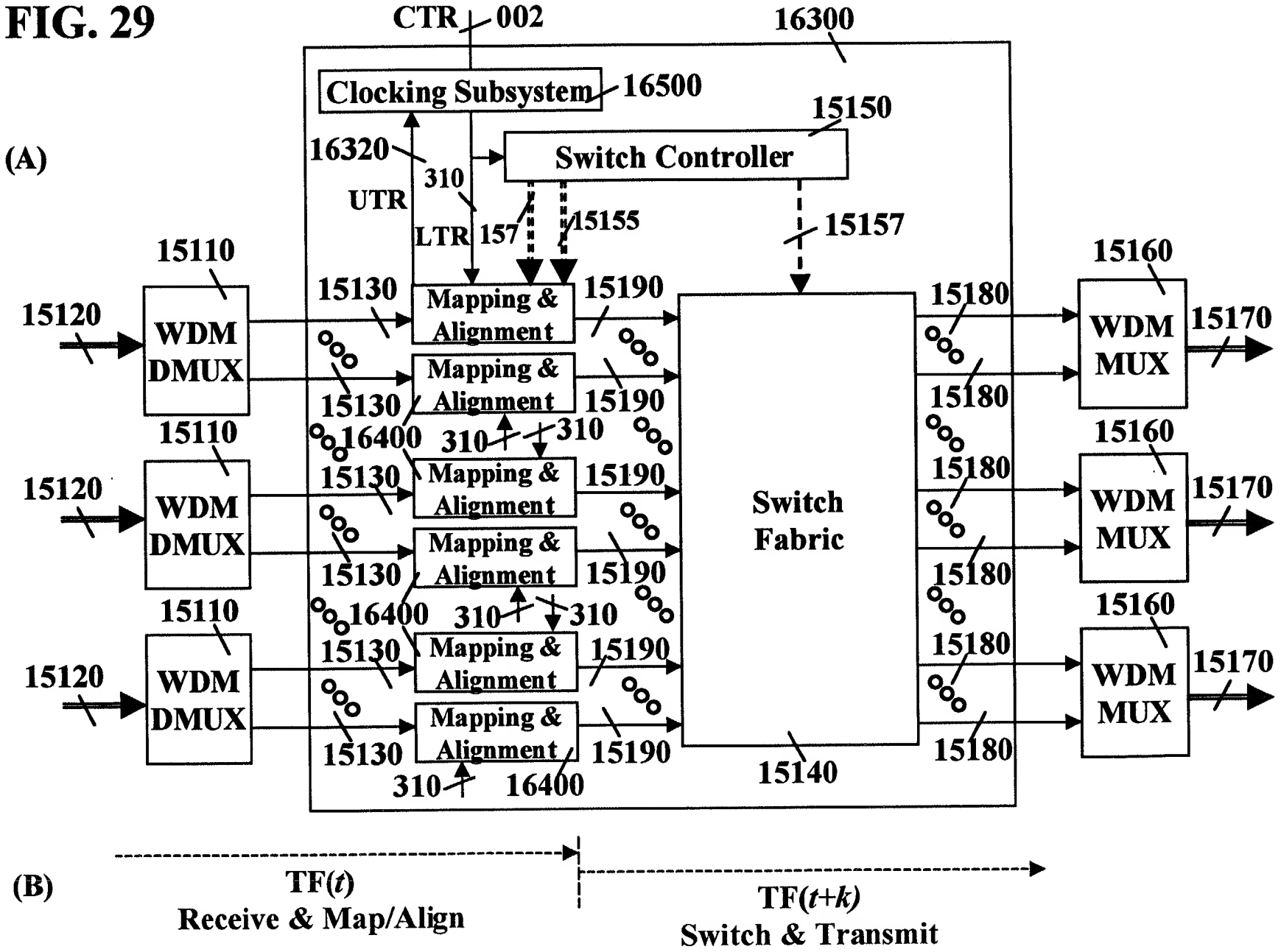


FIG. 30

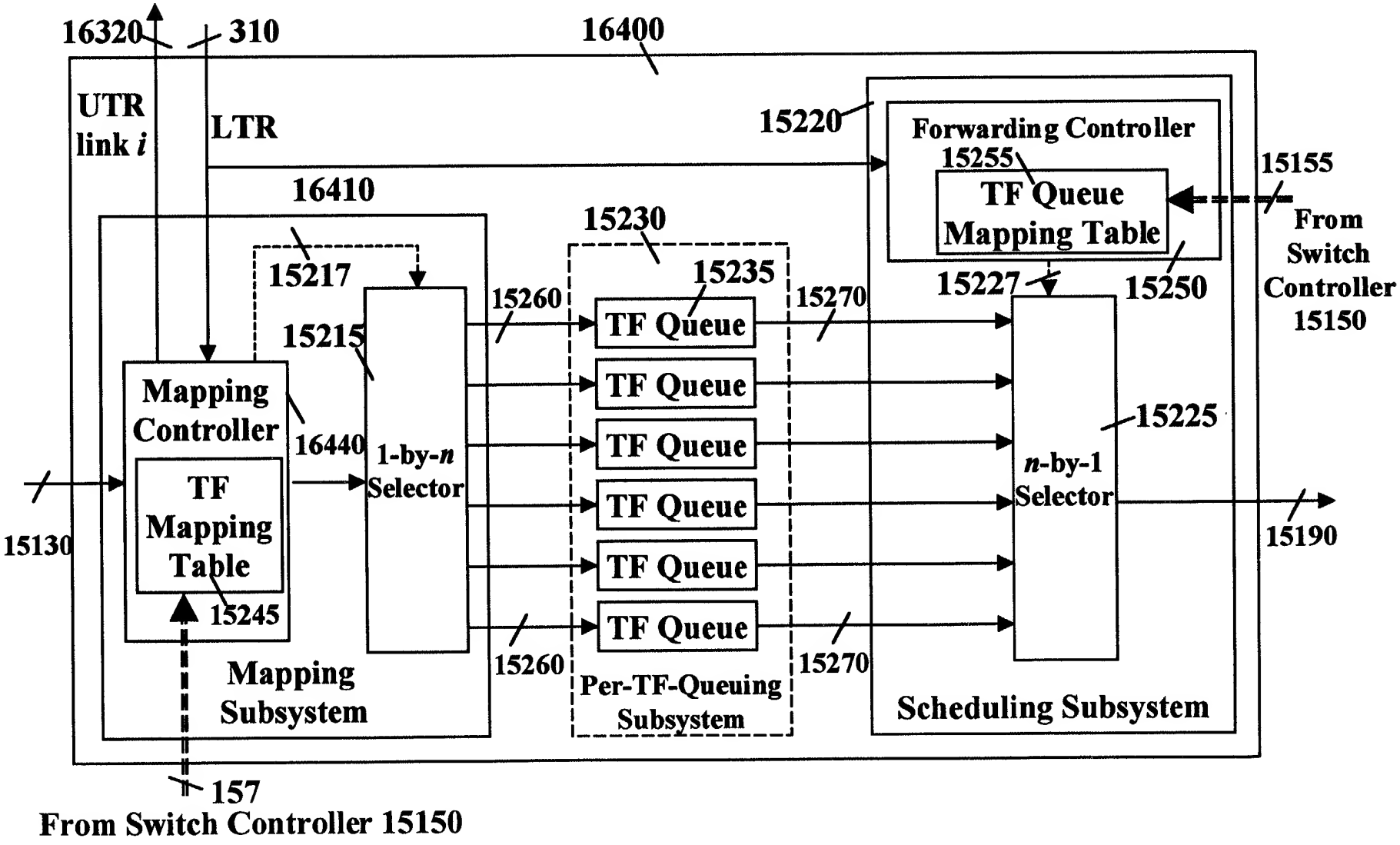


FIG. 31

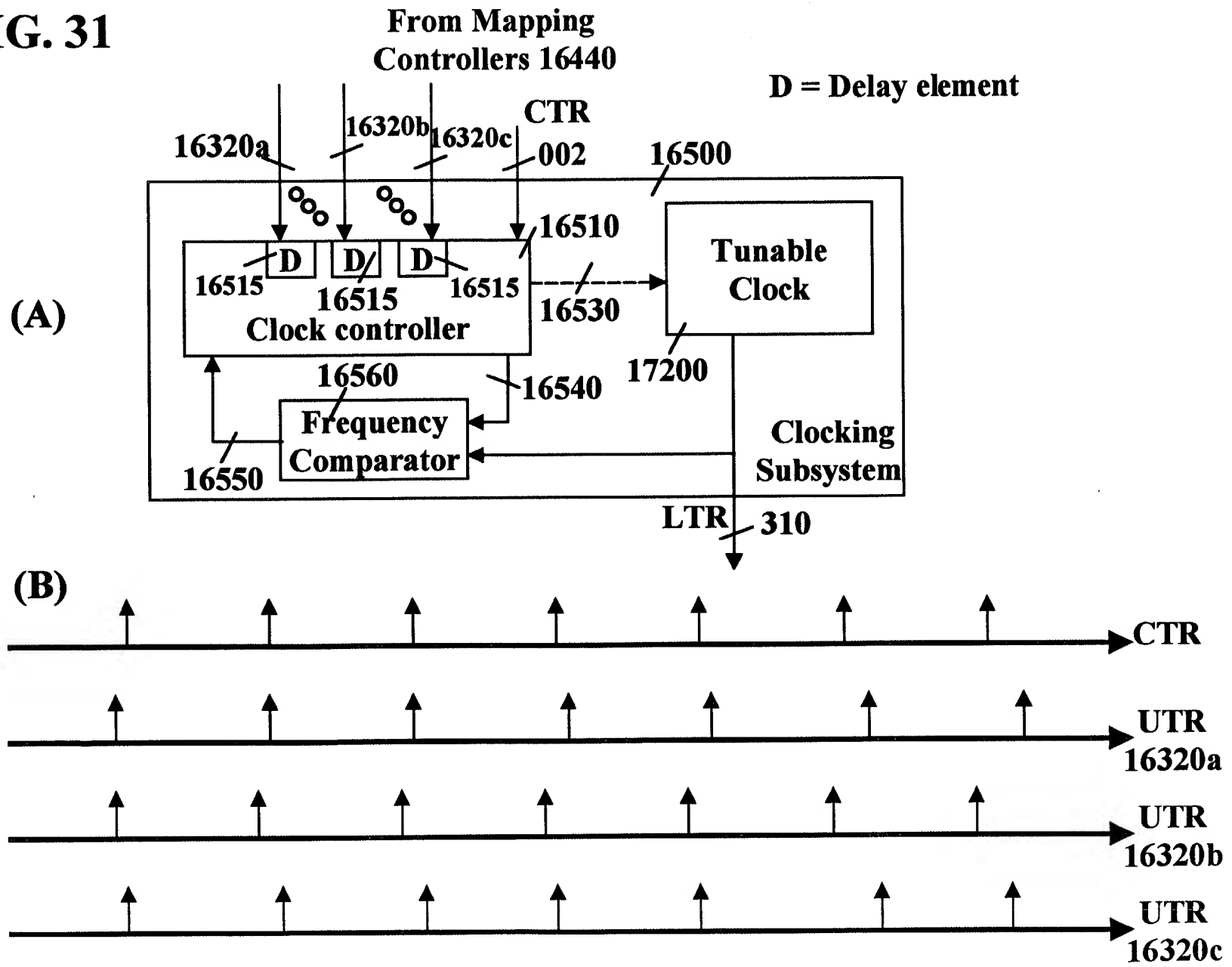


FIG. 32

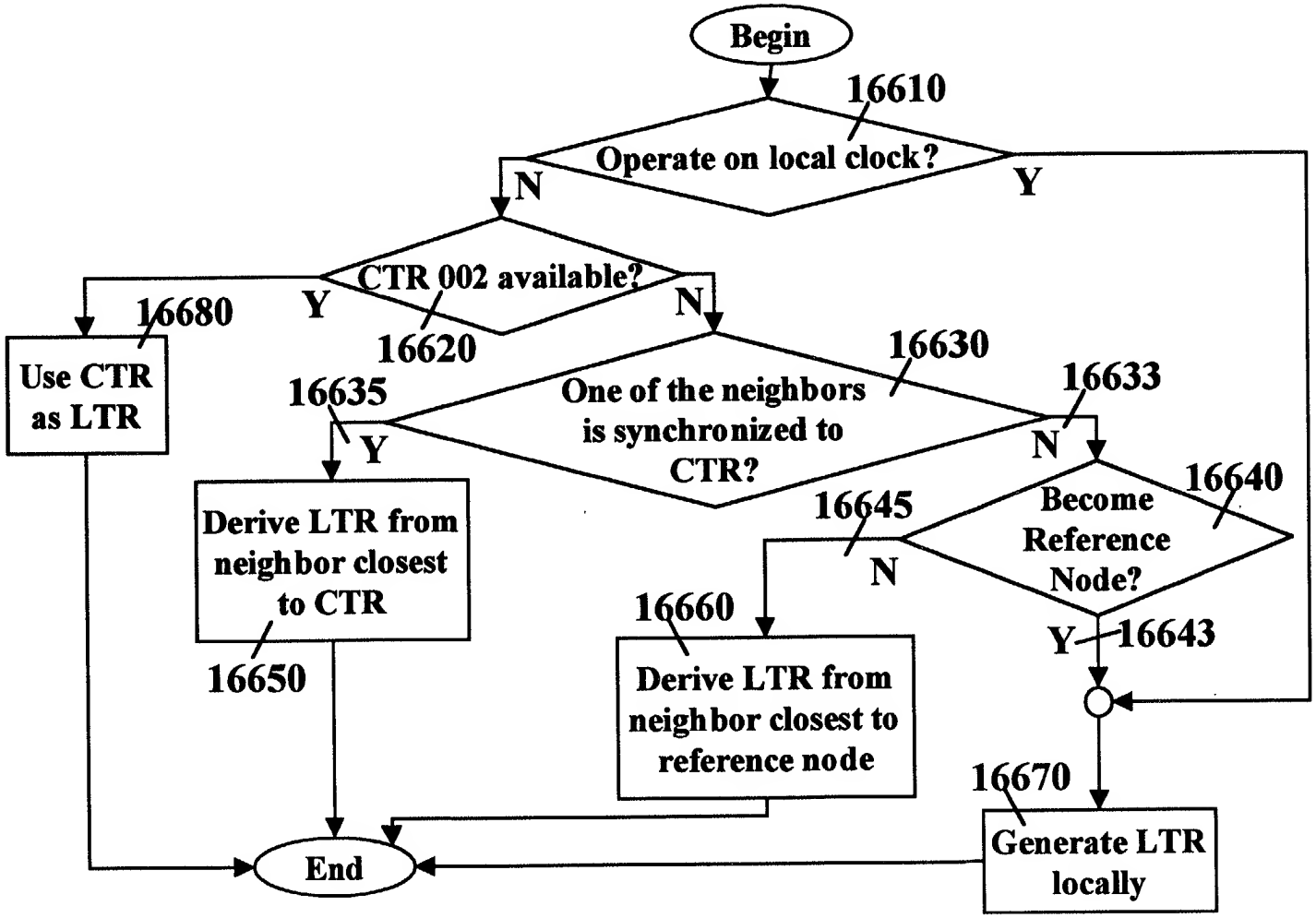


FIG. 33

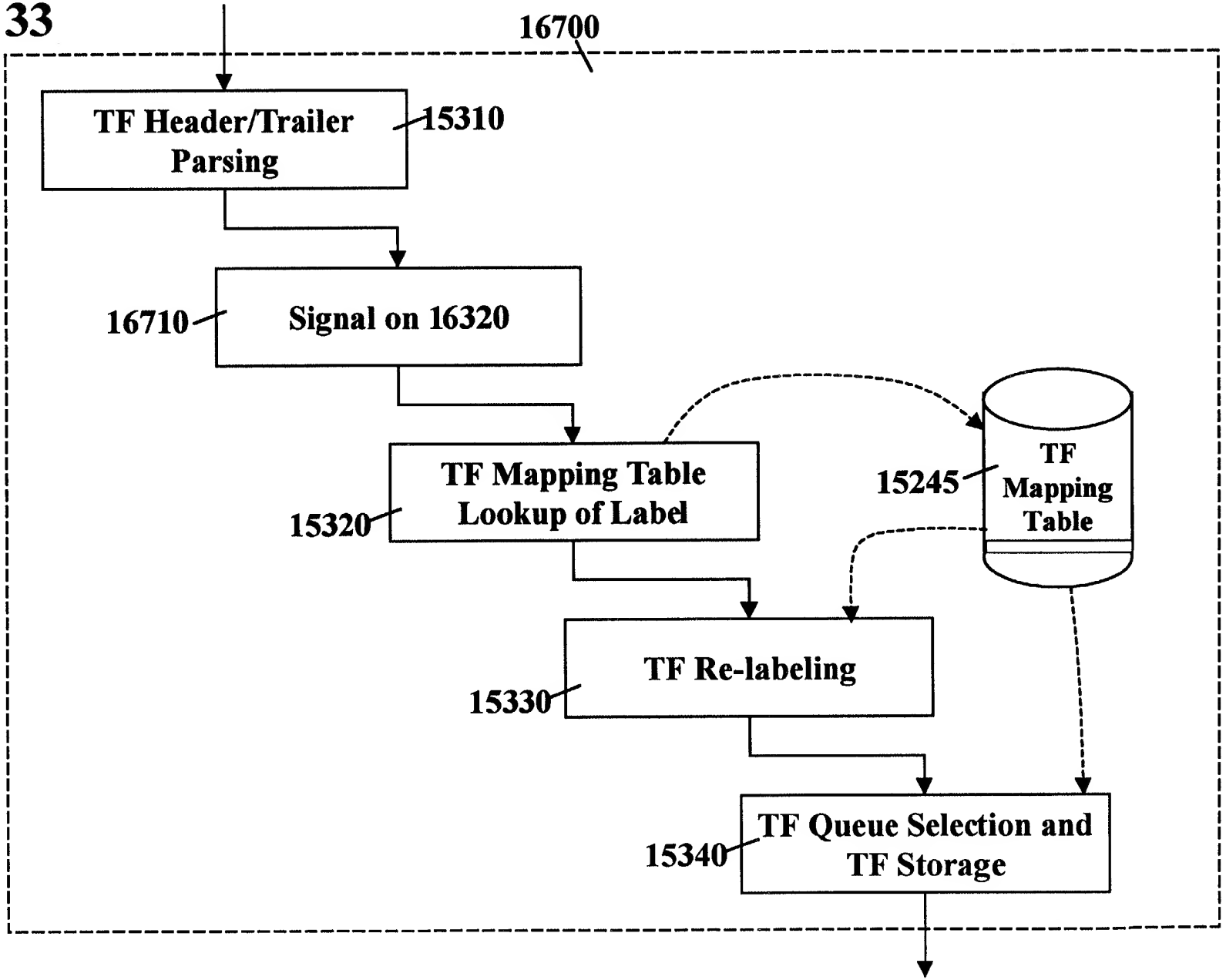


FIG. 34

TF duration [μs]	# TF queues	Memory req. [Kbytes]	Clock accuracy	Stratum	Tolerance D	H	M	S
7.8125	20	195	1.00E-10	1	7	16	27	42
7.8125	20	195	1.60E-08	2	0	1	9	10
7.8125	20	195	4.60E-06	3	0	0	0	14
7.8125	20	195	3.20E-05	4	0	0	0	2
7.8125	200	1,953	1.60E-08	2	0	13	21	35
7.8125	200	1,953	4.60E-06	3	0	0	2	47
7.8125	200	1,953	3.20E-05	4	0	0	0	24
7.8125	1000	9,766	1.60E-08	2	2	19	36	48
7.8125	1000	9,766	4.60E-06	3	0	0	14	6
7.8125	1000	9,766	3.20E-05	4	0	0	2	1
15.625	20	391	1.00E-10	1	15	8	55	25
15.625	20	391	1.60E-08	2	0	2	18	20
15.625	20	391	4.60E-06	3	0	0	0	28
15.625	20	391	3.20E-05	4	0	0	0	4
15.625	200	3,906	1.60E-08	2	1	2	43	11
15.625	200	3,906	4.60E-06	3	0	0	5	34
15.625	200	3,906	3.20E-05	4	0	0	0	48
15.625	1000	19,531	1.60E-08	2	5	15	13	36
15.625	1000	19,531	4.60E-06	3	0	0	28	13
15.625	1000	19,531	3.20E-05	4	0	0	4	3
31.25	20	195	1.00E-10	1	30	17	50	50
31.25	20	195	1.60E-08	2	0	4	36	41
31.25	20	195	4.60E-06	3	0	0	0	57
31.25	20	195	3.20E-05	4	0	0	0	8
31.25	200	1,953	1.60E-08	2	2	5	26	22
31.25	200	1,953	4.60E-06	3	0	0	11	9
31.25	200	1,953	3.20E-05	4	0	0	1	36
31.25	1000	9,766	1.60E-08	2	11	6	27	12
31.25	1000	9,766	4.60E-06	3	0	0	56	26
31.25	1000	9,766	3.20E-05	4	0	0	8	6

FIG. 35

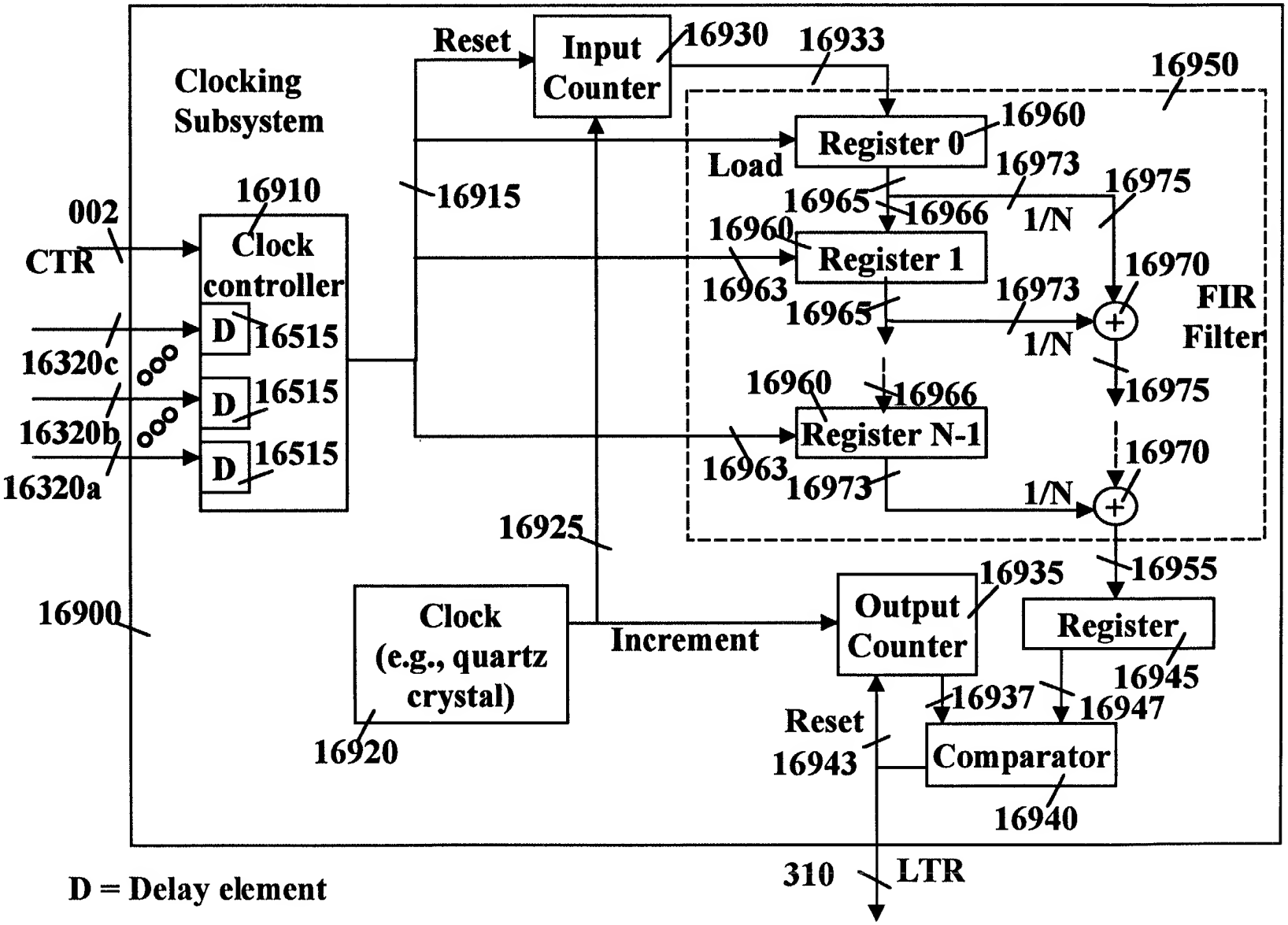


FIG. 36

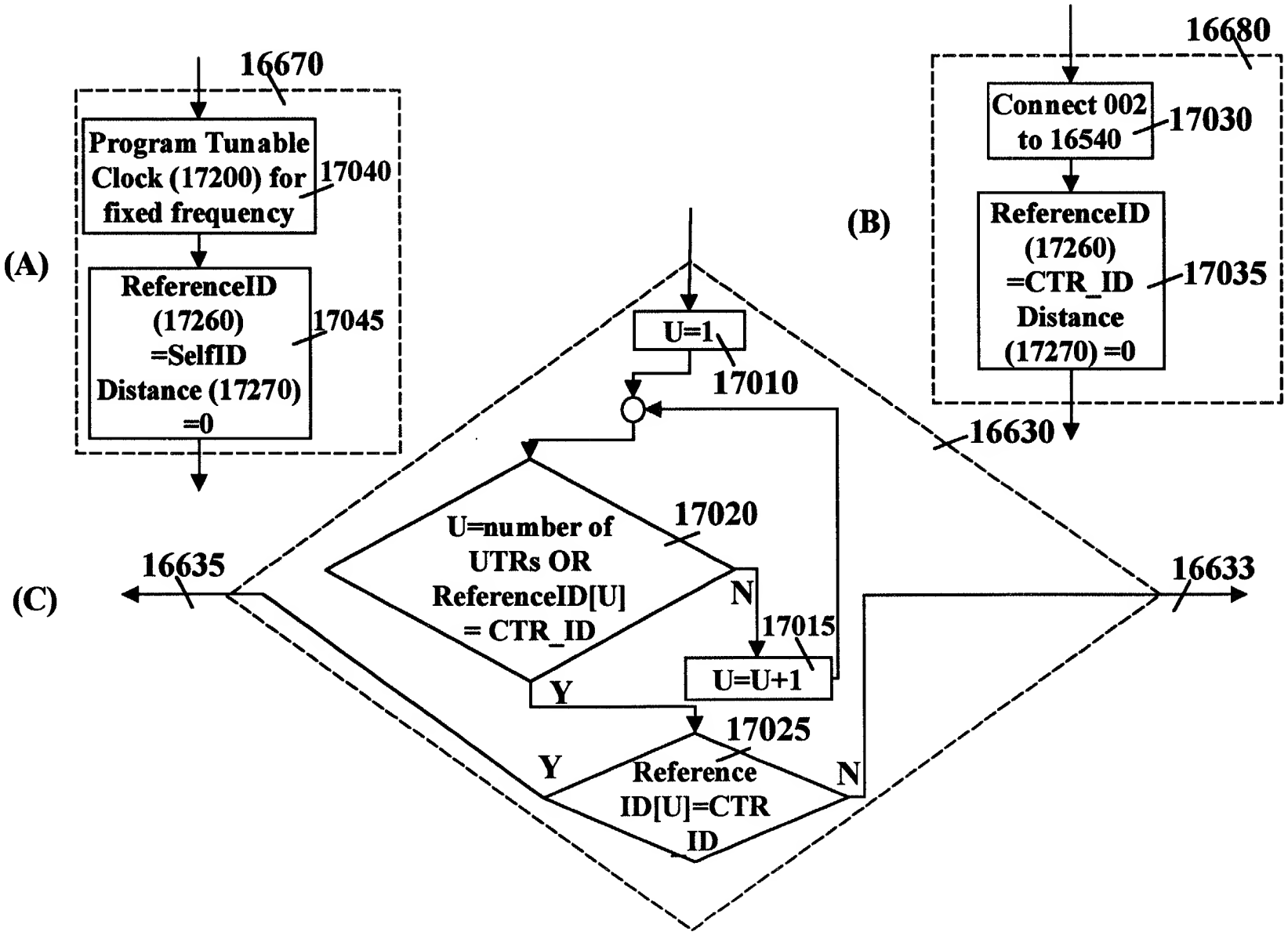


FIG. 37

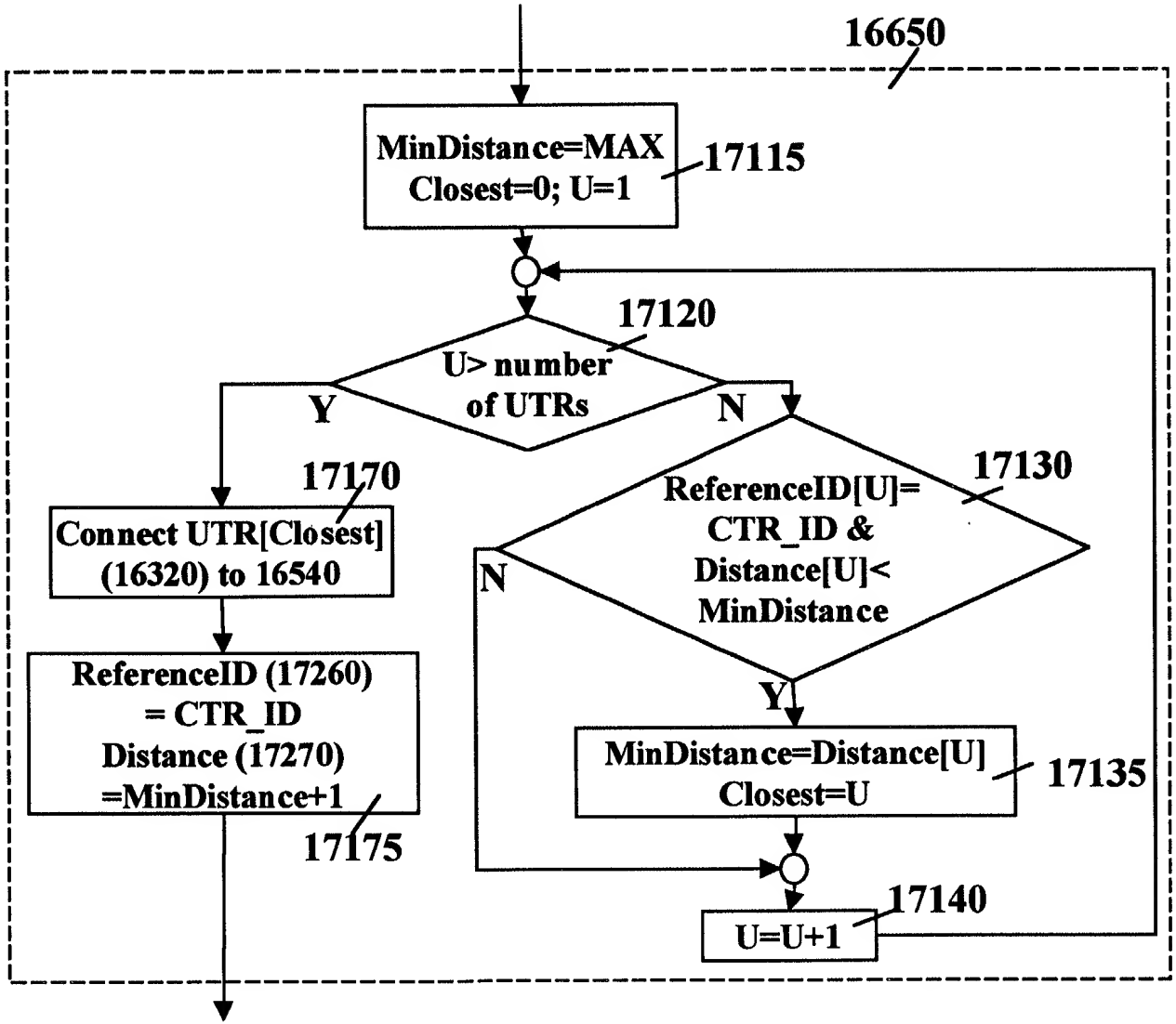


FIG. 38

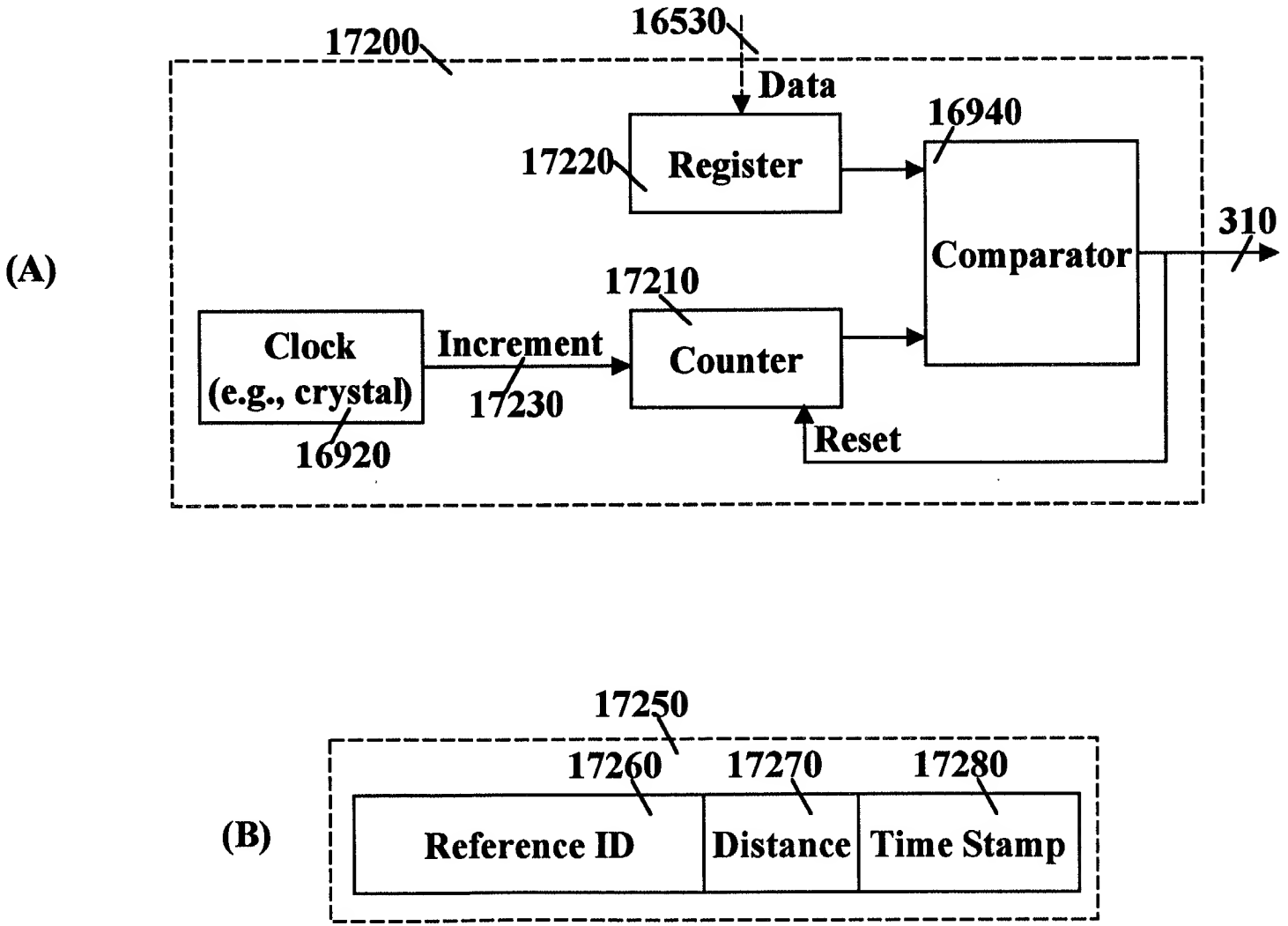


FIG. 39

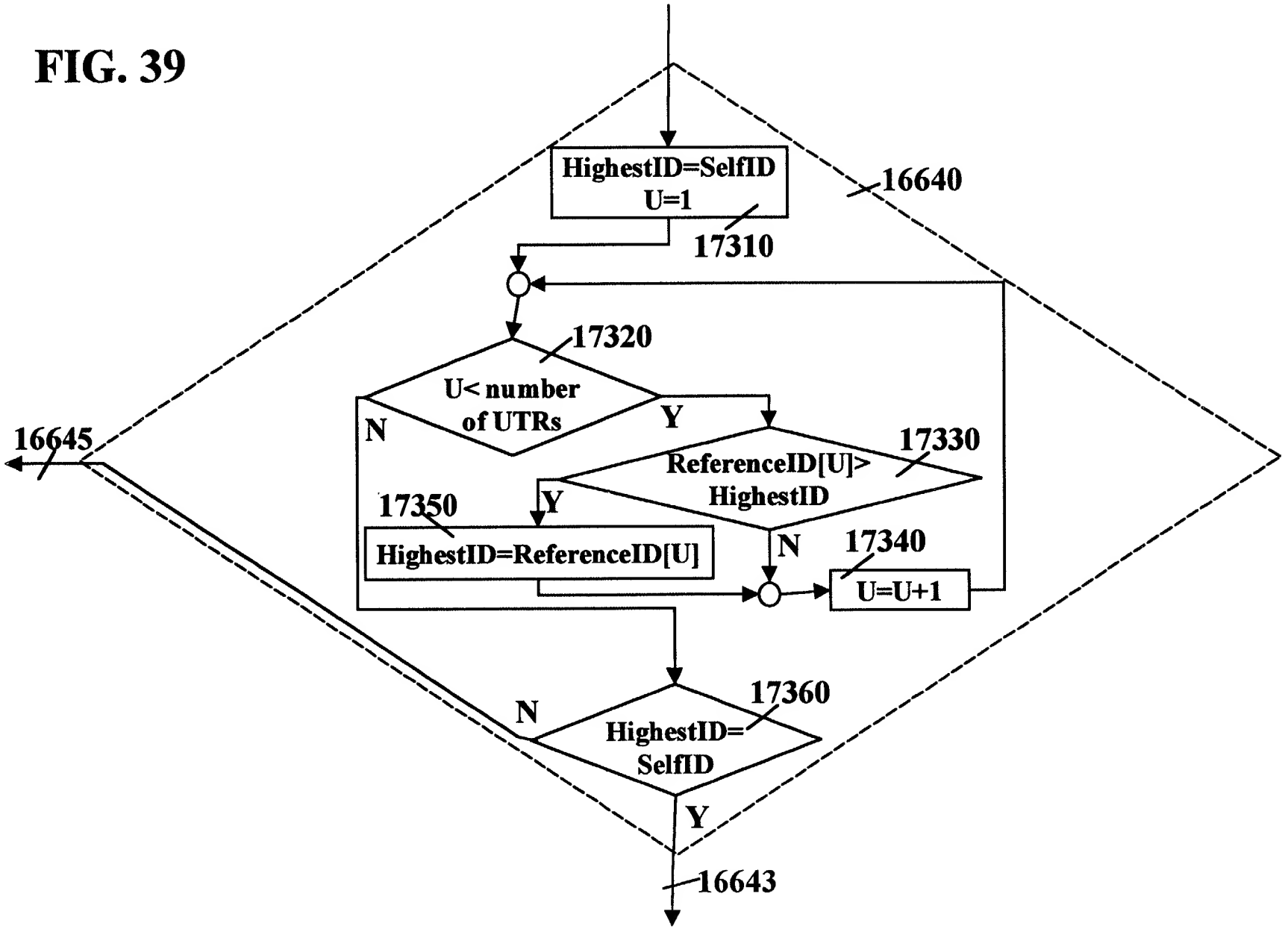


FIG. 40

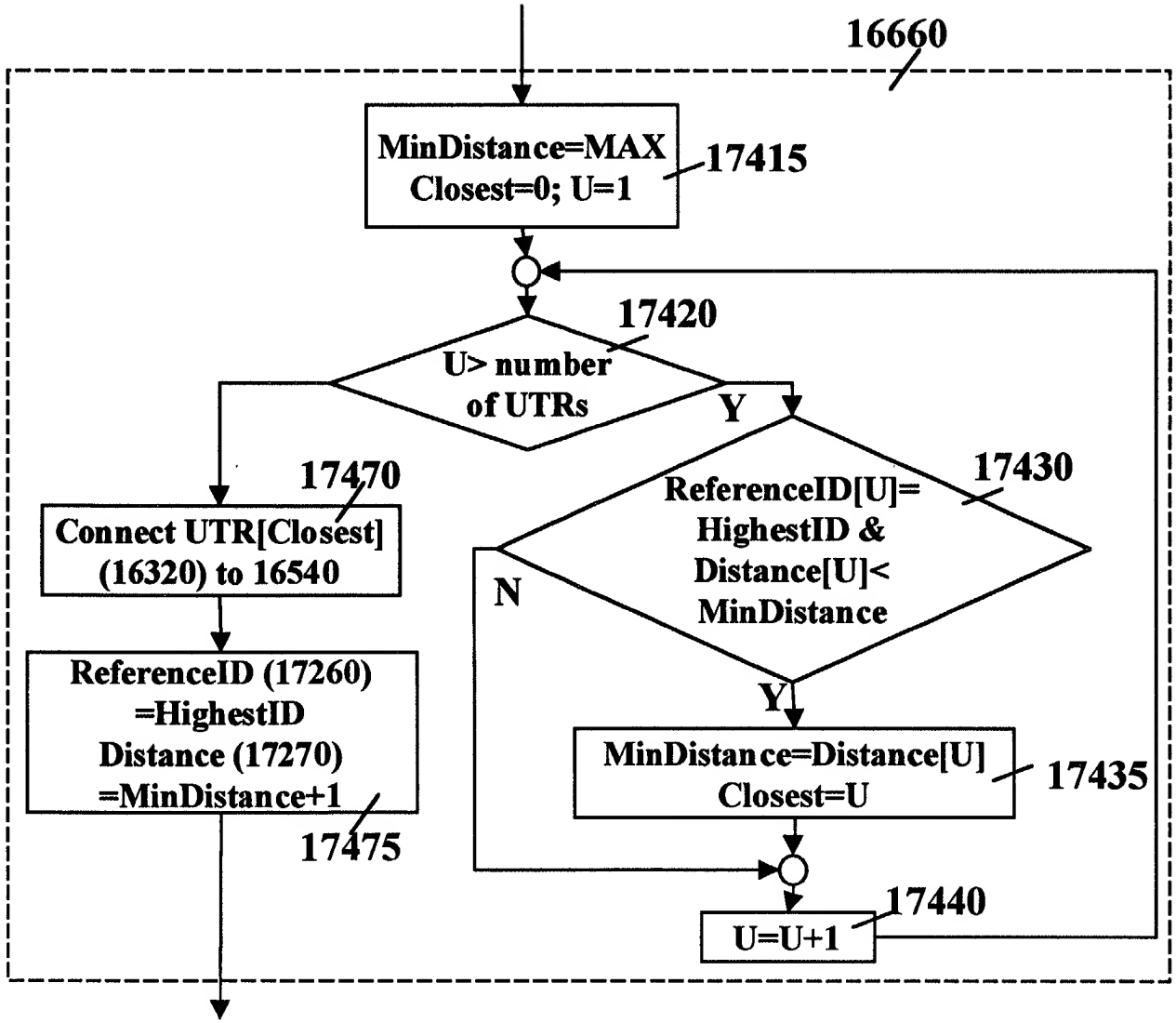


FIG. 41

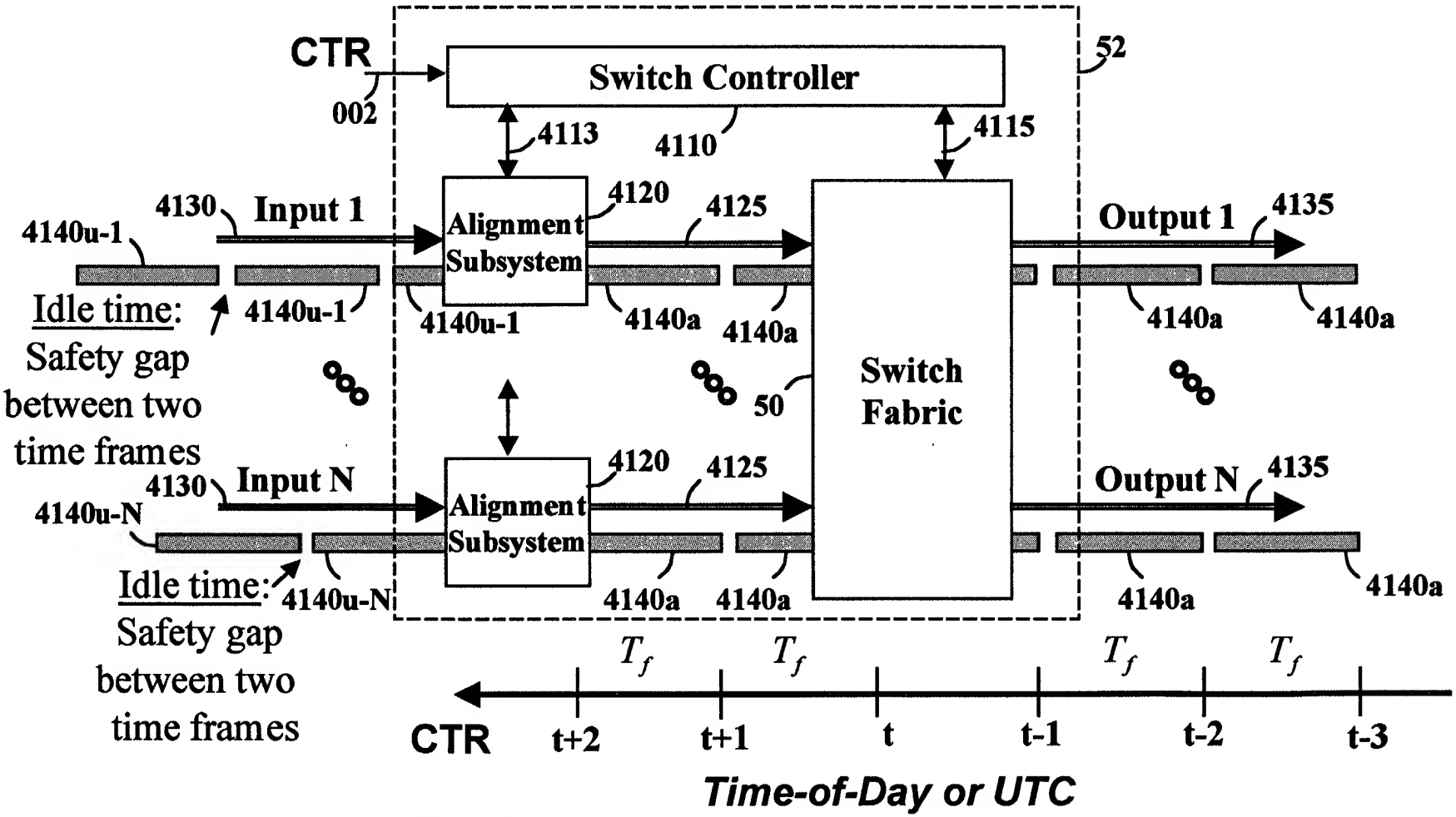


FIG. 42

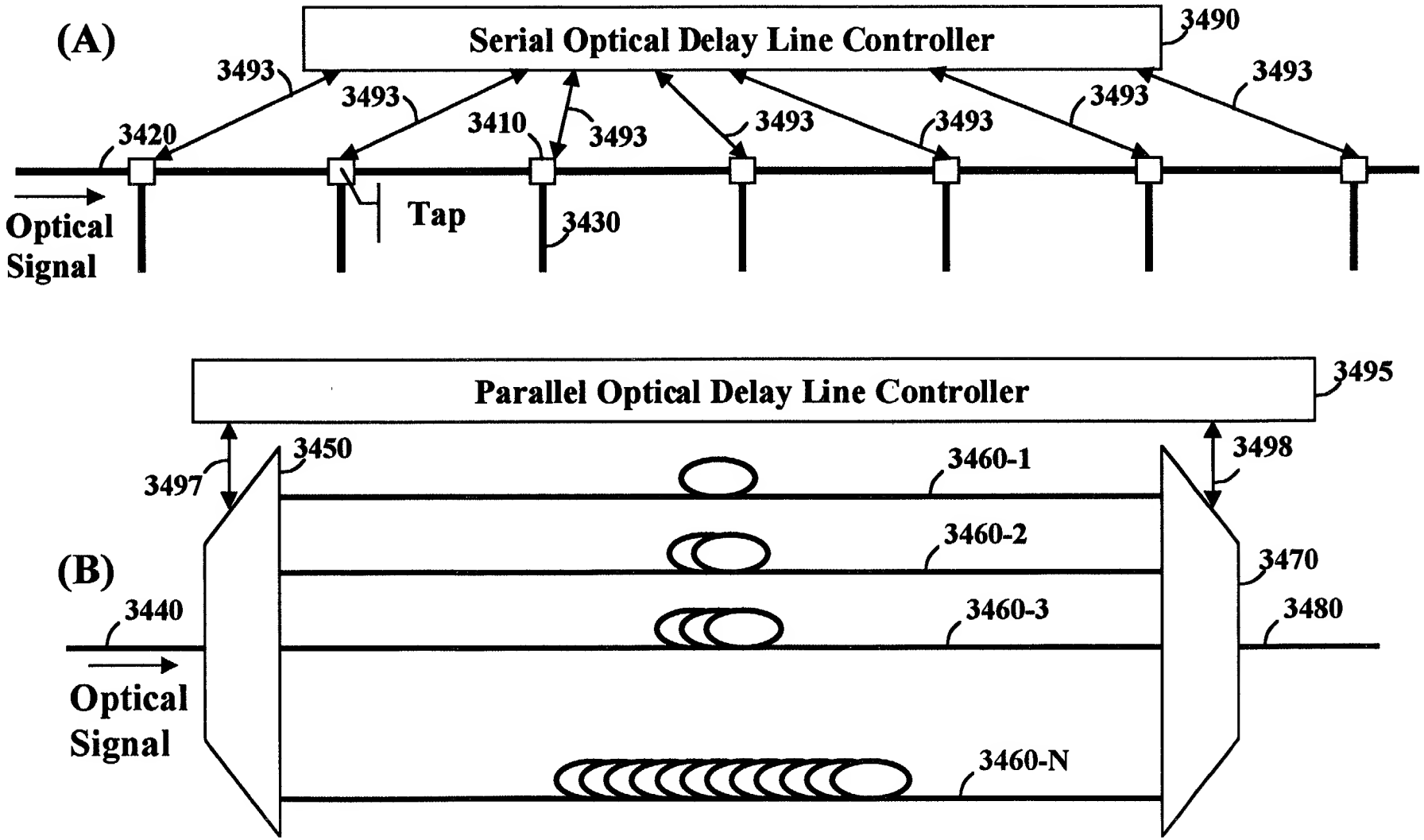


FIG. 43

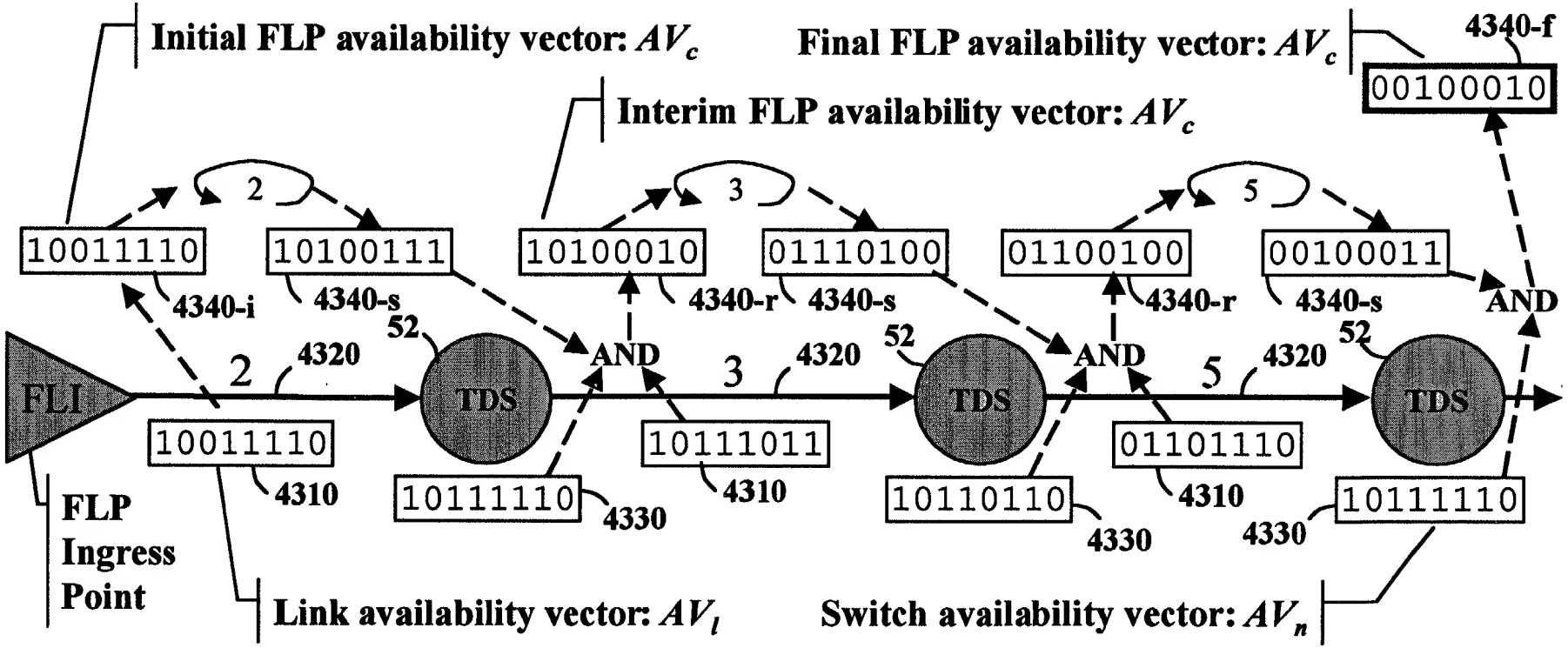
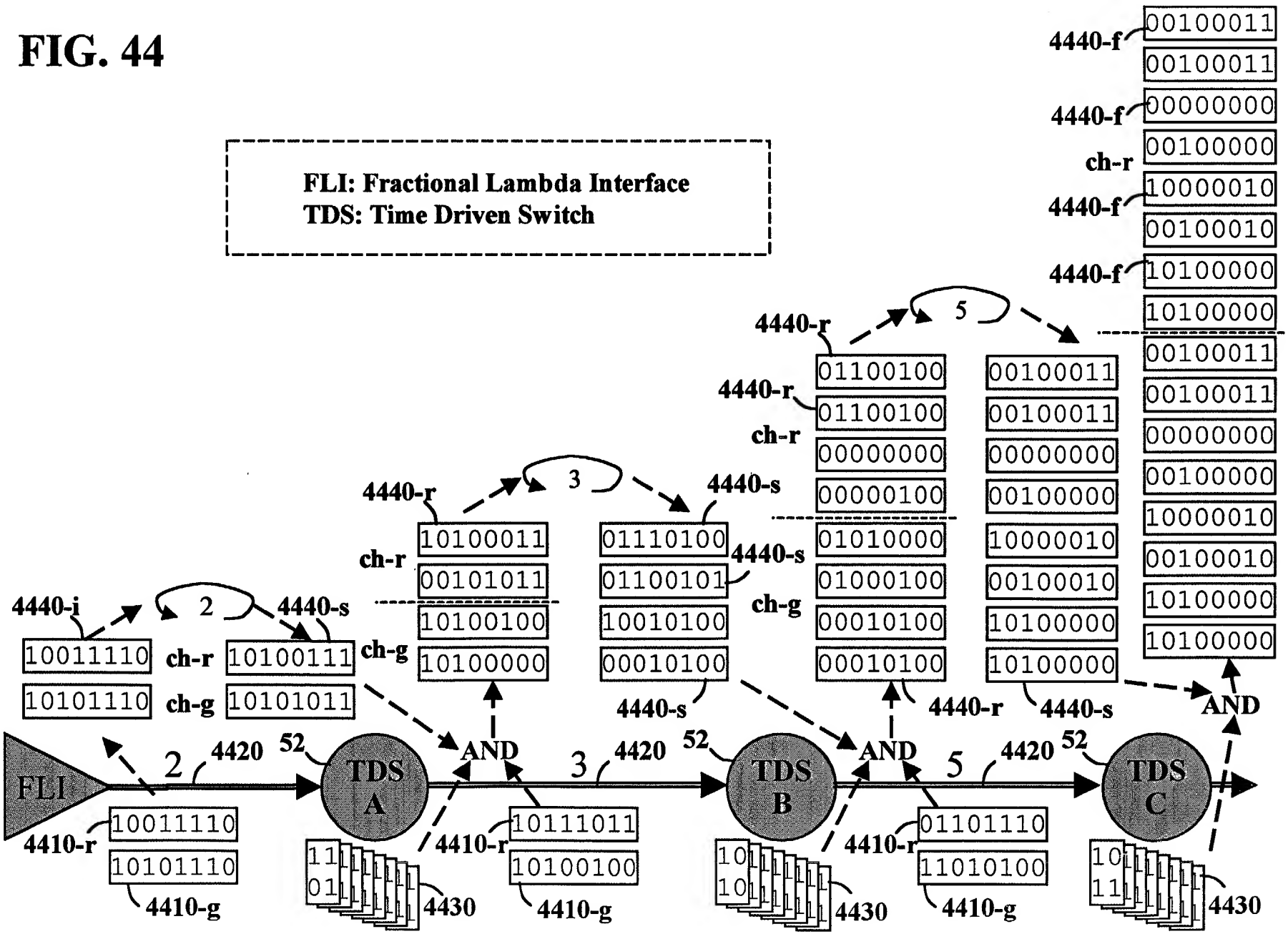


FIG. 44


FLI: Fractional Lambda Interface
TDS: Time Driven Switch
FLI
TDS A
TDS B
TDS C
AND
4440-i
4440-r
4440-s
4440-f
ch-r
ch-g
4410-r
4410-g
4420
4430
52
2
3
5
10011110
10101110
10100111
10101011
10100011
00101011
10100100
10100000
01110100
01100101
10010100
00010100
01100100
00000000
00000100
01010000
01000100
00010100
00100011
00000000
00100000
10000010
00100010
10100000
10100000
10111011
10100100
01101110
11010100